DOCUMENT RESUME

ED 246 643 EC 170 039

AUTHOR Spellman, Charles R.; And Others
TITLE Research and Development of Subjective Visual Acuity Procedures for Handicapped Preschool Children. Final Report.
INSTITUTION Kansas Univ., Lawrence. Bureau of Child Research.
SPONS AGENCY Special Education Programs (ED/OSERS), Washington, DC.
PUB DATE 31 Oct 82
GRANT G007901961
NOTE 95p.
PUB TYPE Reports - Research/Technical (143) -- Guides - General (050)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS Infants; Preschool Education; *Screening Tests; Test Construction; Test Reliability; Test Validity; *Visual Acuity; *Visual Impairments
IDENTIFIERS *Parsons Visual Acuity Test

ABSTRACT

The project was designed to develop an alternate testing method for the visual acuity assessment of preschool children with handicaps. Additional project objectives included evaluation and modification of existing experimental procedures for discrimination training and visual acuity testing of preschool handicapped children; establishment of a criterion for referral for vision screening of 18-to 48-month old children; dissemination of subjective visual acuity procedures to field test sites; and identification of marketing sources to make the materials commercially available. Data on a battery of visual acuity tests administered to preschoolers are presented, indicating that the PVAT (Parsons Visual Acuity Test) had sufficient reliability and validity to serve as a visual acuity screening instruments for preschoolers. Following field test reports and descriptions of dissemination activities, the PVAT manual is presented. (Author/CL)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED246643

FINAL REPORT FROM

RESEARCH AND DEVELOPMENT OF SUBJECTIVE VISUAL ACUITY PROCEDURES FOR HANDICAPPED PRESCHOOL CHILDREN U.S. OFFICE OF EDUCATION GRANT: #G00-79-01961

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
✓ This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

Charles R. Spellman, Ed.D.
Pamela J. Cress, M.S.
Andrea C. Sizemore, Ph.D.

CONTRIBUTING STAFF:

Terry DeBriere
Janis Johnson
Janice Northam
Richard Shores
Judy Scott
Jan Grady
Sue Ott

Bureau of Child Research
University of Kansas
Parsons Research Center
October 31, 1982

Produced by the project for Research and Development of Subjective Visual Acuity Procedures for Handicapped Preschool Children under grant #G00-79-01961 from the U.S. Department of Education, Office of Special Education. The opinions expressed herein do not necessarily reflect the position or policy of the U.S. Department of Education, and no official endorsement should be inferred.

EC170039

Table of Contents

Abstract 1

Introduction 2

Objective A. Evaluation and Modification of Training Procedures 4

Objective B. Establish Criterion for Referral for 18- to 48 month-old Children 12

Objective C. Field-Test Sites 39

Objective D. Disseminate Project Information and Identify and Select Marketing Sources to Make the Materials Commercially Available 50

References 56

Acknowledgments 57

Appendix A. Parsons Visual Acuity Test for the Difficult-to-Test Manual in previously marketed kit . . . .

ABSTRACT

Visual acuity, the degree of keenness or sharpness with which an individual sees, is generally measured by the client telling, or otherwise indicating to the tester, whether or not he can read letters or figures on an eye chart. Most children below the age of five, especially those with handicaps, are unable to follow the tester's instructions and respond in a traditional manner. Thus, preschool students are left untested for visual acuity. Should they have a visual impairment, this handicap goes undetected and uncorrected.

The overall goal of this project was to develop an alternate testing method for visual acuity assessment, using operant conditioning and errorless learning procedures which would permit the evaluation of the majority of preschool handicapped children. Further, this project will make the assessment procedures and materials readily available for use with the target population at the close of the project. The specific objectives were to:

A. Continue to evaluate and modify existing experimental procedures for discrimination training and visual acuity testing of preschool handicapped children;

B. Establish a criterion for referral for vision screening of 18- to 48-month-old children;

C. Disseminate the subjective visual acuity procedures to 10 to 15 field-test sites throughout the nation;

D. Identify and select marketing sources to make the materials commercially available.

The end product of this project is a prototype visual acuity test kit that can be used by school nurses, public health nurses, preschool teachers, and vision screeners. The kit will include material and equipment required to teach the necessary discriminations and to complete visual acuity threshold testing for most handicapped preschool children between the ages of 18 to 48 months. For children whose vision problems are not correctable with lenses or other treatment procedures, the threshold testing procedures will allow the classroom teacher to determine the size of instructional materials needed for a visually handicapped child.

Introduction

Visual acuity tests traditionally require persons being tested to read, label, or otherwise correctly discriminate between test targets of decreasing sizes. Thus the acuity threshold is indicated by the smallest figures that one can reliably identify. Since standard tests require complex receptive and expressive language skills and other learned behaviors, a large group of individuals, including handicapped persons and all young children, have not been testable.

In the course of developing visual acuity assessment procedures for severely handicapped persons, the authors demonstrated that acuity could be measured by greatly simplifying the instructions, response, and format of the testing, while applying operant conditioning techniques to maintain reliable responding. For students unable to respond to the simplified format, errorless procedures were developed for training a discrimination when necessary. Previous experience with a small number of normal and handicapped subjects ages 18 months to 48 months indicated that these children can also be tested using the procedures developed for the severely handicapped. This project has adapted these procedures to allow visual acuity testing to be conducted at an age when treatment will be most effective and when educational losses can be avoided.

Statement of the Problem

Available visual assessment procedures are inadequate for most handicapped preschoolers because such children are unable to respond appropriately to test directives that require them to produce reliable, valid information concerning their visual systems. Since visual assessment is a prerequisite to effective education, some accurate assessment procedure was urgently needed to evaluate the visual acuity of preschool handicapped children.

Since accurate assessment of visual acuity is essential for the identification and treatment of visual impairments, visual acuity tests are used routinely as screening tools for school-aged children and adults. Similar testing is done by optometrists and ophthalmologists to measure the effectiveness of glasses, surgery, eye patching, and other treatments. Without a reliable measure of an individual's functional vision, adequate vision care is not possible.

The importance of vision testing for young children is given added significance because the most common serious visual impairments (amblyopia, strabismus, cataract) must be treated by age six. After that age, visual improvement is unlikely. Paradoxically, children presently receive vision screening or care for the first time at about age six, resulting in late identification and significant visual losses which could have been pre-

vented by earlier treatment. These problems exist to an even greater extent with preschool handicapped children who are handicapped further by the typical approach of waiting until they gain the skills to perform on the standard tests.

The importance of visual acuity testing, and consequent professional treatment, cannot be overemphasized. The normally developing child obtains information primarily through visual and auditory input, and an undetected impairment of one of these primary senses may result in delayed development in motor, language, and cognitive skills. Success in school programs dealing with language, pre-academic, and academic skills is heavily dependent upon the student's ability to use visual stimulus materials. Tasks such as number, letter, and word recognition rely almost entirely on vision. Pictures, drawings and photographs are often used as visual stimuli to elicit language responses. Therefore, it is critical to identify and correct visual impairments at the earliest possible age to maximize the child's potential for learning.

Once the visual acuity procedures had been modified to be used effectively with 18- to 48-month-old children, an additional research question had to be answered before wide-spread preschool vision screening could occur. Since subjective acuity testing had not previously been done with this age group, there was no normative data from this population. This project has established criteria for referral at various ages within the target population through a comparative study in the second year. This study compiled subjective and objective data on a large number of preschool handicapped children, and determined an appropriate cut-off score for correct referrals as indicated by ophthalmological examinations.

Objectives

The goal of this project was to assure that preschool-aged handicapped children have access to assessment procedures that provide a reliable measure of their visual acuity. In order to meet this goal, the investigators proposed to:

A) Continue to evaluate and modify existing experimental procedures for visual discrimination training and visual acuity testing of preschool handicapped children;

B) Establish a criterion for referral for vision screening of 18- to 48-month-old children;

C) Disseminate the subjective visual acuity procedures to 10 to 15 field-test sites throughout the nation;

D) Disseminate project information and identify and select marketing sources to make the materials commercially available.

A discussion of each of these objectives is contained in this report.

Objective A. Evaluate and modify existing experimental procedures for discrimination training and visual acuity testing of preschool handicapped children.

The development efforts of this project focused on modifying two aspects of the existing Parsons Visual Acuity Test (PVAT): 1) identifying more effective discrimination training procedures to reduce the number of persons untestable, and 2) reducing the time required to complete testing of preschool children. Research areas included modifications of the discrimination training program, use of reinforcing consequences for correct performance, and partial automation of the testing procedures. These areas will be discussed briefly in terms of development efforts and conclusions in each area.

Modifications of Discrimination Training Program

Research was conducted to determine the effectiveness of the 30-step intensity-fading program with handicapped 18-48 month old preschool children. A pilot study was conducted at the Verdigris Valley Preschool (VVPS) for Developmentally Disabled Children in Independence, Kansas. Fourteen students of VVPS were administered the PVAT by a trained examiner. Of the 14 subjects, 10 were able to perform on the PVAT (gained reliable threshold scores) with little or no training. The four remaining subjects were unable to perform on the pretest and received five sessions of discrimination training using the intensity-fading program; of these, two subjects successfully completed discrimination training.

A second study was conducted comparing the 30-step intensity-fading discrimination program with a shortened 18-step version of the same program. Subjects included four 18-24 month-old nonhandicapped children

who could not perform on the pretest. Subjects received up to five sessions of training. All four subjects, two of whom were assigned to each program (short or long version), acquired the discrimination and were able to meet criteria on the nine-trial pretest. No apparent differences were seen in the number of trials or sessions to criteria.

The technique of errorless discrimination training involves the gradual transition from an easy to a more difficult discrimination. Just how gradual this transition must be in order to avoid errors varies from subject to subject. Further pilot work using shortened versions of the discrimination training programs with handicapped subjects did not often result in savings of time, trials, or sessions. Many subjects did not progress errorlessly through the shortened versions of the training program and ultimately required more lengthy training to learn the discrimination than similar subjects who only received the full-length training programs. A few subjects who failed to learn the task at any time could conceivably have been successful had they not been biased by errors committed in the shortened training sequence. These experiences support a recommendation that the training program not be shortened unless the subject has demonstrated success in progressing through the full-length program but is consistently unable to complete the sequence in one session.

Based on the project's on-going literature review as well as consultation with other researchers, especially Dr. Murray Sidman, it was hypothesized that an errorless stimulus-shaping program could be effective for training the discrimination of "hand." Preliminary studies indicated that the stimulus-shaping program was feasible. Also, a

question existed as to the relative effectiveness of two procedures for correcting errors, referred to as back-up and re-presentation procedures. When using the back-up procedure, an error response was followed by presentation of the last step in the program that the subject had successfully completed. In "re-presentation" an error response was followed by presenting the same trial, rather than returning to an earlier step in the program.

A study was completed to evaluate the two discrimination training programs (intensity fade and stimulus shape) using the two procedures for correcting errors. Ten residents of Parsons State Hospital and Training Center (PSH&TC) were selected as subjects. The subjects had no previous experience with the PVAT discrimination training program nor had they been successfully screened by other vision screening instruments. All subjects failed the PVAT pretest. In a counter-balanced design, they were then exposed to the four combinations of the discrimination programs and the error correction procedures (intensity fade, back-up; intensity fade, representation; stimulus shape, back-up; stimulus shape, representation). Results indicated that four of the ten subjects learned the discrimination while the other six subjects failed to learn under any of the four conditions. In retrospect, it was determined that the number of subjects in this study was too small to identify the "best" appróach due to the rigorous criteria for subject selection which precluded the selection of all but the most resistant learners. (Almost all residents at PSH&TC had already been exposed to one or more of these programs.) Recognizing the need for additional data on the relative effectiveness of these approaches, the decision was

made to include both programs and both correction procedures in the field test. The results of the field test will be discussed in Objective C.

Semi-Automated Reinforcing Device

A semi-automated device was developed which allowed for automatic activation of electronic "events" when the subject pressed a touch plate. The device, described below, is illustrated in Figure 1. The device consisted of four parts: a touch plate, a foot switch, a controller, and electrically-activated "reinforcing" events (toys, tape players, fans, etc.). The touch plate served as a platform for the test stimulus card, and contained light sensitive optical sensors which read the correct response from the back of the coded stimulus card. The touch plate had three clear plastic 2" X 2" windows behind which the stimulus cards were displayed. When a subject pushed against the window which displayed the hand, an electromechanical switch was activated to turn on one or more of the electrically-activated "reinforcers."

The controller was an electronic device with latency timer and reinforcer operating circuits. (The latency measure was included to explore the feasibility of using latency as well as accuracy of responses to determine acuity thresholds. In previous work with older subjects testers observed that subjects' latency of response increased as thresholds were approached. Subsequent analysis of latency data from preschoolers showed no such systematic increase, and no useful information was gained by recording latencies.) The controller monitored electrical inputs from the foot switch and card holder. When the foot switch was pressed the latency timer began, counting the seconds until the subject pressed

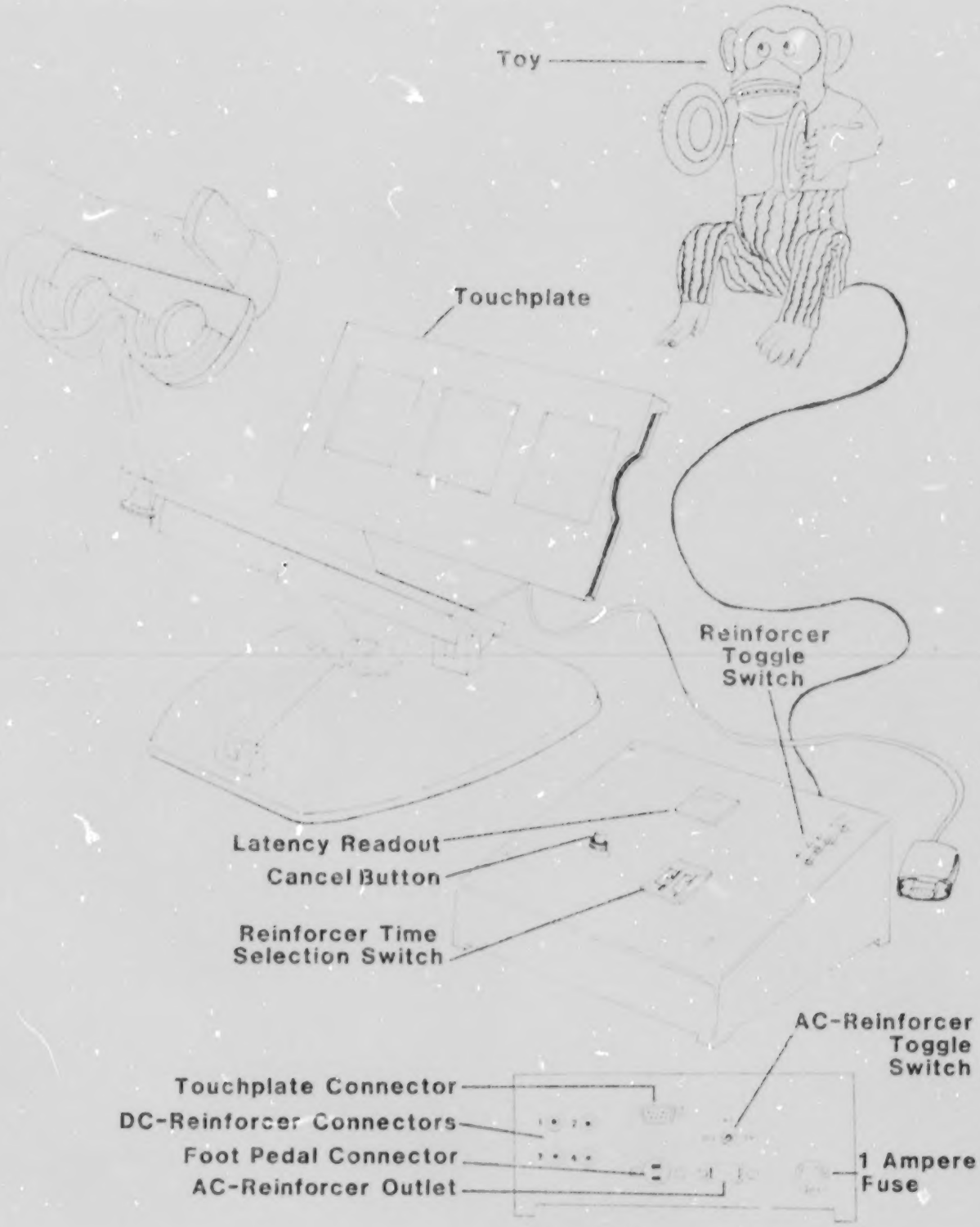


Figure 1
PVAT - Semi-Automated Device

one of the three response keys on the card holder or until the tester pressed a cancel button; either event stopped the latency timer. If the subject pressed the correct test target (hand), a "reinforcer" was activated by the controller for a specified length of time (in seconds) pre-set by the tester using a running-time selector located in the front panel of the controller. The experimenter recorded the time displayed in the latency readout along with the subject's response. Up to four different "reinforcers" could be activated by the controller simultaneously, with the tester selecting various sequences or combinations of "reinforcers." This selection was controlled by a set of toggle switches with on-off positions.

The device was used to administer the PVAT in the following manner: The tester placed the appropriate test card behind the touch plate, pressed a foot switch which activated a latency timer, and simultaneously said "Show me hand." The child pressed one of three windows (hand, cake, bird) and, if the response was correct (hand), an electrically operated "reinforcer" was activated for a specified length of time (e.g., 3 seconds).

Selection of Reinforcing Events. Our previous research with older subjects involved the use of edible reinforcers. Pilot work with younger subjects indicated that edibles were not always effective due to the subject's lack of skills in chewing, swallowing and drinking from a cup. Project staff hypothesized that young subjects might be reinforced by "events" such as action toys or music which would provide visual and/or auditory stimulation without manipulation by the subject.

Several pilot studies were conducted in an effort to identify which of the available electrically activated "reinforcing" events were, in fact, reinforcers for preschool children. Subjects were 18-48 months old. In order to look at the reinforcing properties of the various events in isolation from task performance variables, a simple button press response was used to determine the rate of responding when different "reinforcing" events were made available to the subjects. The project also investigated the effect of reinforcement length (3 seconds vs. 5 seconds of activation). Of the four "reinforcing" events used (music, train, pinwheels with fan, TV with cartoons) only TV with cartoons produced high rates of responding with no apparent satiation effect.

During the course of these pilot studies project staff were searching toy stores for appropriate action toys and discovered a variety of inexpensive "wind-up" toys made by the Tomy Corporation that displayed various movements when an internal spring was wound. During pilot work with wind-up toys as reinforcers, testers observed that young subjects appeared to enjoy these toys (i.e., watched them, smiled or laughed, indicated their desire to see them again).

In comparing the use of electrically activated events with wind-up toys it became apparent that both had some advantages and disadvantages. The electrically activated events ensured immediate reinforcement and did not involve the human trainer. However, the equipment and materials were expensive, cumbersome in field use, and required frequent repair. The most popular "event" during the pilot work, TV with cartoons, proved impractical in the field due to the lack of portability and the need to

electronically modify each TV monitor used. Wind-up toys, on the other hand, were inexpensive, portable, and surprisingly durable in field use. The disadvantages of wind-up toys were that they required activation by the human trainer, and some dexterity was required to deliver these reinforcers immediately following correct responses. Trainers also felt that wind-up toys increased overall session length as compared to the automated reinforcers. In an effort to gain more information on the relative usefulness of these two types of reinforcement, both electrically activated events and wind-up toys were used in the field-test (see Objective C).

In the process of completing these development activities, project staff screened approximately 300 handicapped and nonhandicapped 18-48 month-old children with the PVAT. A variety of daycare centers, preschool programs and other agencies throughout southeast Kansas provided subjects for this activity.

Objective B. Establish a criterion for referral for vision screening of 18- to 48-month-old children.

Rationale

Previous efforts to develop preschool visual acuity tests have yielded a few tests which have been validated through empirical investigation (see Stangler, Huber, & Routh, 1980 for a thorough review of preschool visual acuity tests). Possibly the most thorough studies of vision screening instruments appropriate to screening preschool children (ages 3 to 6 years) were completed by Taubenhaus & Jackson (1967). These researchers provided comparison of the Snellen Illiterate "E," Allen Picture Cards, Sjorgen Hand Test and the Titmus Screener, among each other and with ophthalmologic examination as the criterion for correct referral. The examiners followed standard procedures for administering the screening tests. Each ophthalmological examination was classified as either positive (referral) or negative (nonreferral) by the ophthalmologists. In instances of disagreement between ophthalmologists, their findings were referred to a panel of consulting ophthalmologists for a final decision. The subjects for the studies are described by age only (ages 3 to 6 years), therefore, the developmental descriptors of the preschool children are unknown (e.g., intellectually accelerated or delayed).

The results indicate that all the tests were fairly reliable on test-retest (agreement ranged from 65% to 92%) with the lowest agreement at the younger age (3 year olds) and highest agreement at the higher ages (5 and 6 year olds). Also the tests related well with each other (agreements ranged from 72% - 97%) as to referral and nonreferral; again

age was a factor (higher disagreement at the younger ages). The number of children who were considered "untestable' by any one of the screening instruments was rather small (approximately 8%) with the majority of untestables being in the 3 to 4 year old age range.

The criteria to estimate the validity of the instruments were the ophthalmologists' examinations. The Snellen E Test agreed with the ophthalmologists' examinations as to referral on 55% of the cases and nonreferral on 85% of the cases. Administration of the Snellen E resulted in a 45% overreferral rate in total number of referrals and 15% underreferrals. The Allen Test results indicated a 48% agreement with the ophthalmologist as to referral and 85% agreement as to nonreferral. Of those referred by the Allen Test, 52% were overreferrals. Fifteen percent of the ophthalmologists' referrals were not identified by the Allen Test (underreferrals). The results of the Sjogren test indicated agreement with the ophthalmologists' tests on nonreferrals (94.5%) and on referrals (54%), with nearly 18% overreferrals. Underreferral rates were not reported. The results of the Titmus screener indicated agreement with the ophthalmologists' tests as to nonreferral on 82% of the cases, with 41% agreement on the referrals and 18% overreferrals.

Although other tests have been designed to screen young children for visual acuity problems (e.g., New York Lighthouse, Faye, 1968), little evidence is available regarding the reliability and validity of the instruments. Even those studies reported above indicate that the children screened were at least three years old with the majority of the subjects over four years of age. No researchers have reported data indicating the validity of visual screening instruments with children as young as

24 months. The younger children in the above studies (ages 3 and 4 years) were more difficult-to-test (e.g., providing low reliability and validity estimates) and more children in these age levels were considered "untestable."

As indicated above, some persons with handicaps and many young children have been untestable or performed unreliably on standard visual acuity tests. Several authors (e.g., Barber & Barmatz, 1975) have indicated that these children lack prerequisite skills such as direction-following and reliable verbal responding which may inhibit appropriate responding on standard acuity tests. Since the Parsons Visual Acuity Test (PVAT), which utilizes operant conditioning and errorless learning principles, proved to be effective with approximately 90% of those persons school-aged and adult who were previously considered untestable (Cress, Spellman, DeBriere, Sizemore, Northam, & Johnson, 1981) it appeared that the procedures might also be useful with a younger group.

The purpose of the study to be discussed was to explore the validity of the PVAT as a screening instrument to identify preschool-aged children (ages 18 mos. to 48 mos.) who have visual acuity deficits and therefore are in need of a professional vision examination and possible treatment. Specifically the following questions were evaluated:

1. What is the normal distribution of scores on the PVAT for preschool-aged children (18 to 48 mos.)?
2. What is the normal distribution of cycloplegic retinoscopy scores or refractive errors for preschool-aged children (18 to 48 mos.)?
3. What is the inter-test reliability of the PVAT?

4. What is the relationship between the results of the PVAT and cycloplegic retinoscopy for preschool-aged children (18 to 48 mos.)?
5. Does the PVAT have predictive validity for making referrals for subjects of preschool-aged children (18 to 48 mos.)?

Procedures

Subjects

A total of 470 preschool children between the ages of 18 and 48 months were recruited from preschools and day care centers in the greater Kansas City area to participate in this study. Three hundred forty-seven children were tested with the Parsons Visual Acuity Test and with objective tests completed by the cooperating professional vision examiners. Table 1 presents the distribution by age and sex of the original group.

Table I

Frequency of Subjects in the Study by Age and Sex

	18-24 Months	25-36 Months	37-48 Months
Male	32	101	110
Female	25	99	103
Total	57	200	213

Subjective Threshold Procedures

All subjects were tested for visual acuity following the procedures described in the preschool PVAT manual which can be found in Appendix A. A subject received a retest on the PVAT if the worst threshold score was

20/40 or 20/60. The lower of the two scores (first and second test) was used as a final score. In those few cases where a second test score was worse than the first, a third threshold was administered and the final score was either the score obtained on two of the three thresholds or the lowest score.

A total of 31 subjects were randomly selected from the original population for the purpose of examining test-retest reliability. The subjects were tested by two different staff members with a week or more between tests. The second test consisted of only one far-point threshold selected as the worst score from the first test; however, the actual score on the first test was not known to the second tester. In cases where all threshold scores were the same, one of the far-point scores was retested. In addition, another 30 subjects were randomly selected to assess test-retest reliability when administered by the same tester. One complete PVAT was conducted, including any retesting, followed by a second PVAT conducted by the same tester with a week or more between tests. On the second testing only one far-point threshold was tested using the worst score from the first test.

Pretesting and Training

To obtain threshold measurements of visual acuity by the PVAT, it was necessary to begin with the pretest to assess the subject's ability to discriminate the hand from the bird and cake symbols used as test targets. Subjects who failed the pretest were then placed into one of two categories. The categories included those children who did not have an appropriate response (e.g., pointing to or matching pictures to indicate the correct test target) and those children who had an appro-

priate response but did not consistently select the appropriate target. Those in the first group were subjected to response training which generally included a physical prompt which was gradually faded until a response was established. Once the response was established, these children began the PVAT discrimination training program. The second group entered the discrimination training program immediately after failing the pretest. The children were required to demonstrate a reliable discrimination response by passing the pretest before threshold assessment was conducted.

Objective Procedures

Professional eye examiners who collected objective data included Gerhard Cibis, M.D., Melanie Crandall, O.D., Joseph Maino, O.D., Valerie Moore, M.D., Mike Sarno,* M.D., Dan King,* M.D., and Bruce King,* M.D. Dr. Maino is director of the Victor Eye Clinic at the Veteran's Administration Hospital of Kansas City and the other doctors are affiliated with the University of Kansas Medical School Department of Ophthalmology.

The battery of objective tests was administered to subjects at mass screenings of up to 60 subjects per day. Volunteers and project staff escorted subjects to each of the six test stations for individual testing. The test battery included:

1. Photographic Brückner - A photograph of each subject was shot and analyzed using the procedure described by Kaakinen (1979).

2. Standard Brückner - A manual procedure for detecting eye muscle imbalance was administered by one of the eye examiners.

*Resident Ophthalmologists at the time this research was conducted

3. Near Retinoscopy - The procedure used was described by Mohindra (1979).

4. Cycloplegic dilation - A low-concentration cycloplegic drug mixed according to the specifications found in the article by Forman (1980), was administered in each eye of the subjects. A 20-minute waiting period followed the administration of the drops.

5. Cycloplegic retinoscopy - Standard far retinoscopy was conducted using hand-held lenses and a motion picture cartoon was used as a 20-foot fixation target.

6. Fundus examination - Indirect ophthalmoscopy was conducted to detect eye pathology.

For the purpose of testing the validity of the PVAT with young children only the cycloplegic retinoscopy data were used in the analyses. The cycloplegic retinoscopy results were examined to determine inter-tester reliability on 29 subjects. These subjects moved from first to second examiner on the same day to repeat the test, and the result of the first test was unknown to the second examiner.

Results

Table II presents the frequency of subjects at various steps in the process of obtaining visual threshold scores by age groups. Of the original 470 children, 416 (88.5%) were successfully screened by the PVAT. From Table II it can be observed that with the younger group, 18-24 month-old children, threshold assessments were more difficult to obtain than with the older children. For example, of the original 57 subjects in the 18-24 month-old age group, only 24 (42%) were successful

Table II

Frequency of Subjects by Age Level at Different Steps in Obtaining PVAT Acuity Scores (Thresholds)

	18-24 Months	25-36 Months	37-48 Months	Total
Initially Began PVAT Screening	57	200	213	470
Passed Pretest and Completed Threshold Testing	17	166	208	391
Failed Pretest	40	34	5	79
Entered Discrimination Training	22	22	4	48
Successfully Completed Discrimination Training	7	17	4	28
Gained Reliable Thresholds After Discrimination Training	7	14	4	25
TOTAL THRESHOLDS	24 or 42%	180 or 90%	212 or 99.5%	416 or 88.5%
Failed to Gain Appropriate Response	18	12	1	31
Unsuccessful on Discrimination Training	15	5	0	20
Passes Pretest but Unable to Perform on Threshold	0	3	0	3
TOTAL UTP UNTESTABLE SUBJECTS	33 or 58%	20 or 10%	1 or .5%	54 or 11.5%

in completing threshold testing of their vision, while for the 25-36 month-old age group, 90% of the subjects were successful in completing the threshold tests and 99.5% of the 37-48 month-old age group successfully completed visual acuity threshold testing. These differences between the age groups are also evident from the data on pretest performance; 70% of the 18-24 month old children initially failed the PVAT pretest, while only 17% of the 25-36 month old children and 2.3% of the 37-48 month olds initially failed the pretest.

It is also evident that training the appropriate discrimination was more successful as the children got older. Of the 22 children 18-24 months old who began training only 7 (31.8%) successfully learned the discrimination and thus were able to complete threshold testing. In the 25-36 month group 22 children began training; 17 (77%) were successful in reaching criterion on the discrimination task (however, three of those children did not complete threshold testing). Of the five children in the oldest group who failed the pretest, one failed to be brought under sufficient control to gain an appropriate response and four successfully completed the training and threshold testing.

Distribution of PVAT Scores: Figures 2, 3, 4, 5, and 6 present the percentage of children by age level whose scores on the PVAT were 20/20, 20/30, 20/40, 20/60, or 20/80 and above. As expected, the majority of the children tested fell in the 20/20 to 20/30 range with the mode for all age levels being 20/30. Table III presents the mean and standard deviations for each age group.

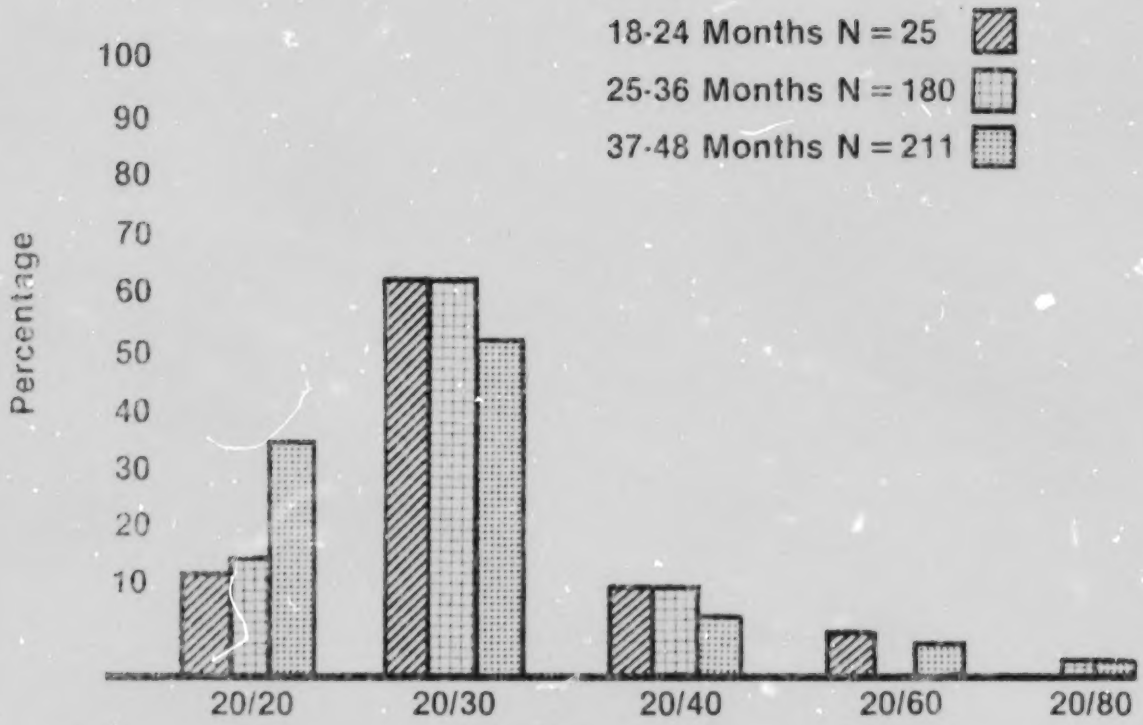


Figure 2

Percentage of Subjects Near-Point Both Eyes—PVAT Visual Acuity Scores by Subjects in each of the Three Age Groups

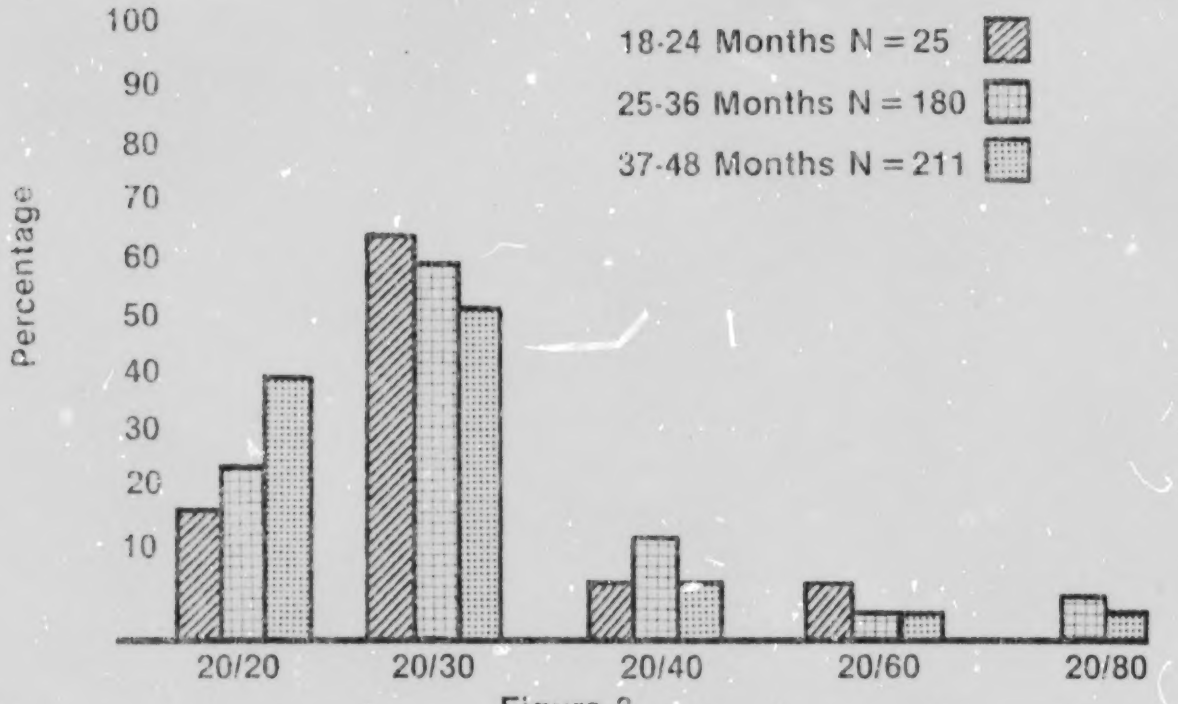


Figure 3

Percentage of Subjects Near-Point Left-Eye—PVAT Visual Acuity Scores by Subjects in each of the Three Age Groups

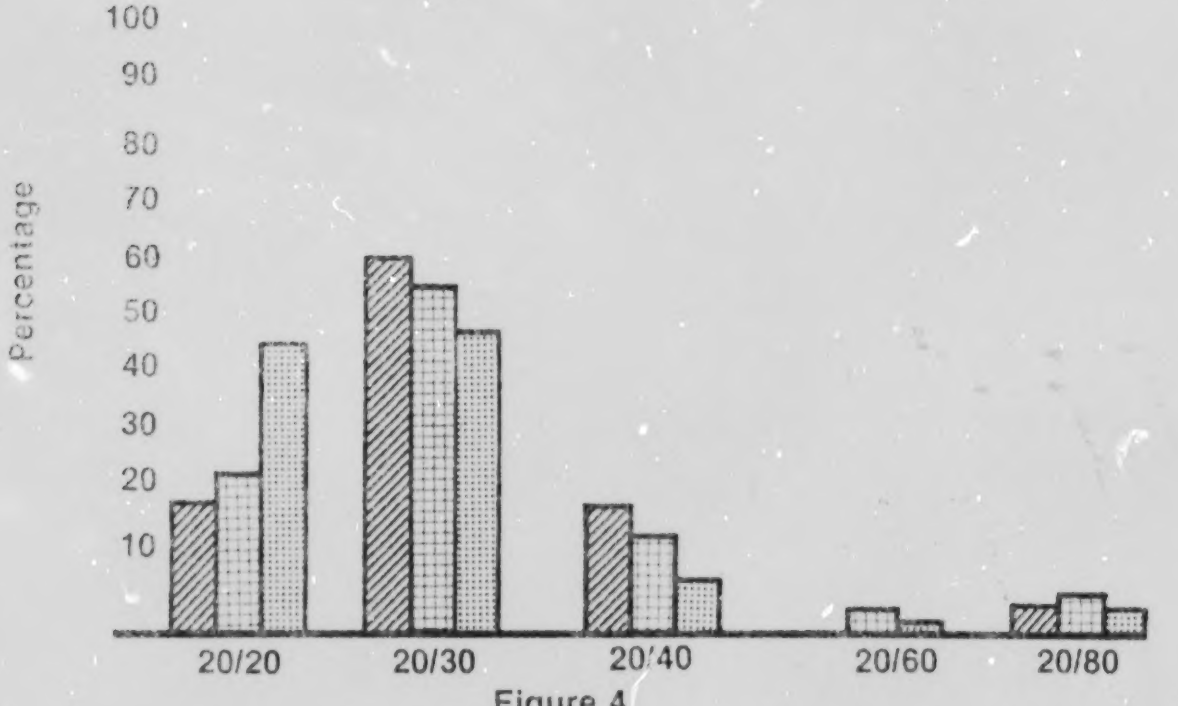


Figure 4

Percentage of Subjects Near-Point Right Eye—PVAT Visual Acuity Scores by Subjects in each of the Three Age Groups

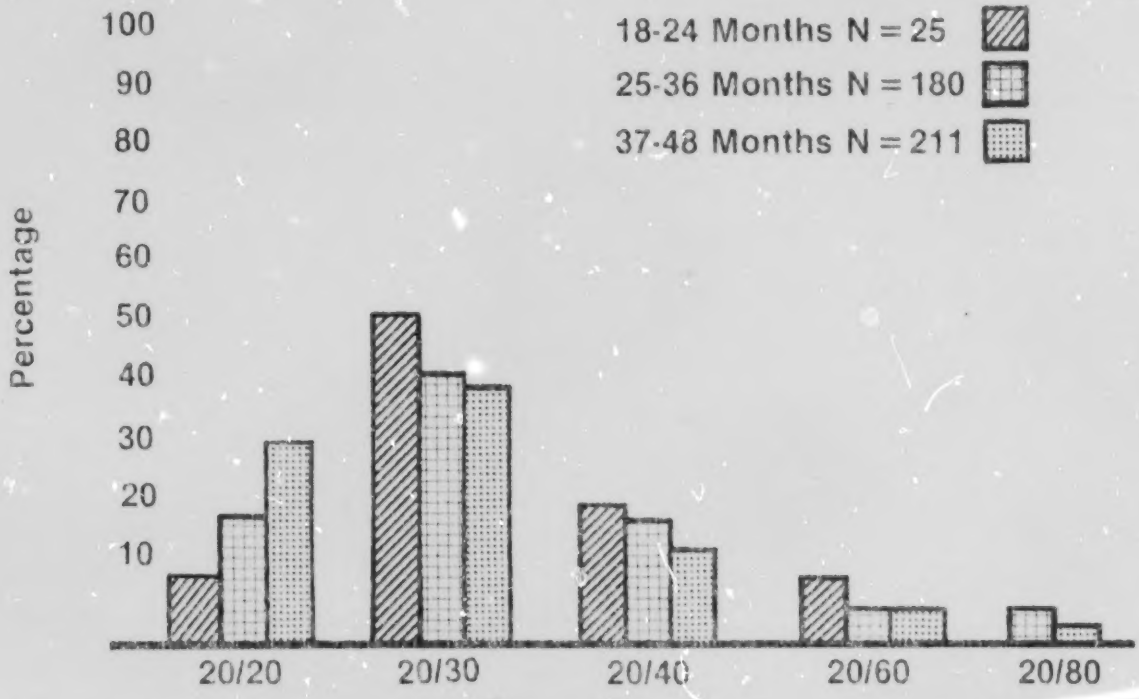


Figure 5
Percentage of Subjects Far-Point Left Eye—PVAT Visual Acuity Scores by Subjects in each of the Three Age Groups

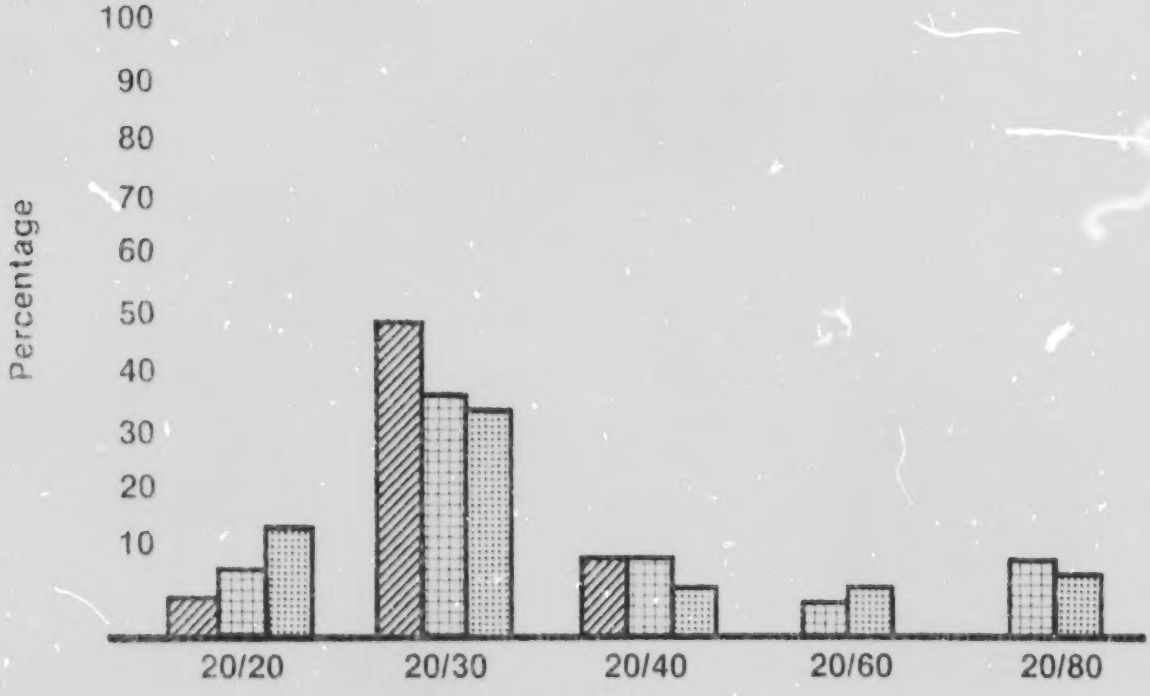


Figure 6
Percentage of Subjects Far-Point Right Eye—PVAT Visual Acuity Scores by Subjects in each of the Three Age Groups

Table III

Summary of PVAT Scores by Age

	Near-Point						Far-Point			
	Right		Left		Both		Left		Right	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
18-24	30.9	5.1	30.4	8.2	30.9	7.9	33.0	7.6	31.3	4.6
25-36	31.1	11.6	32.5	16.5	31.1	11.6	37.2	18.6	36.7	18.7
37-48	27.69	9.27	28.25	12.2	33.66	17.75	33.65	15.58	32.5	15.58

Reliability of the PVAT

Test-Retest reliability

Subjects. Thirty subjects ranging in age between 20 months to 48 months, with an average age of 36 months, were randomly drawn from the original subject population of 470 preschool children from the Kansas City area.

Procedures. Each subject was individually administered the PVAT on two separate occasions by the same tester. On the first testing the entire PVAT was completed with thresholds obtained at near- and far-point in each eye. On the second testing only the eye which was considered the "worst" eye at far-point on the first test (or if both scores were equal, either eye) was retested using the PVAT far-point procedures. The second test was administered one week to 10 days following the first test.

Results. The results of this test/retest were analyzed using a chi-square procedure. The results indicated a Chi-square of 46.8 which, with degrees of freedom of nine, resulted in a probability of zero that

the data were independent (See Table IV). Therefore, one may assume that the test/retest scores were dependent upon each other; it is highly likely that on a test/retest using the same tester the children would score similarly. The PVAT appeared to provide reliable information regarding acuity scores.

Further analyses of these data indicated that there was 93% overall agreement between the two tests as to whether the children should (20/40 or higher) or should not be referred (20/20 or 20/30) for further testing (87% agreement on referral and 95% agreement on nonreferrals). [Note: These referral criteria were used for analysis of data, but have subsequently been modified. See Summary and Discussion, page 35.]

Table IV

Four by Four Contingency Table
for the Test/Retest of the PVAT

		Test 2				
		20/20	20/30	20/40	20/60 & Over	TOTAL
Test 1	20/20	4	0	0	0	4
	20/30	4	13	1	0	18
	20/40	0	1	4	0	5
	20/60 & Over	0	0	1	2	3
	TOTAL	8	14	6	2	30

Inter-Tester: (Same children tested by two different testers)

Subjects. Thirty-one children with ages ranging from 20 months to 48 months and an average age of 36.7 months, were evaluated independently by two separate testers.

Procedures. The first tester completed the entire sequence of the PVAT while the second tester administered the far-point test to each subject, which the earlier testing had identified as "the worst eye" at far-point, or either eye chosen if the scores were equal on the first administration.

Results. Results were analyzed using the Chi-square procedure. Table V provides the 4 x 4 contingency table. The results of the Chi-square analysis indicated a Chi-square of 26.2 with a probability of .002. Again, this indicates that the hypothesis of independence should be rejected, thereby allowing an interpretation that the test scores were dependent upon each other. Overall agreement between the two testers indicated a 74% agreement as to whether or not the children should be referred (acuity score of 20/40 or more) or not referred (acuity score of 20/30 or less). Sixty-eight percent agreement was found on nonreferrals (children who fell below the 20/40 score) but only 54% agreement on referrals (children who fell in the 20/40 and above range of acuity scores).

Table V

Four by Four Contingency Table
for the Inter-Tester of the PVAT

		Test 2				
		20/20	20/30	20/40	20/60+	TOTAL
Test 1	20/20	6	2	1	0	9
	20/30	3	6	3	1	13
	20/40	0	3	2	1	6
	20/60 & Over	0	0	0	3	3
	TOTAL	9	11	6	5	31

Although the above analyses appear to support strong test/retest reliability, we were concerned with the differences in the referral scores when two different testers evaluated the children. That is, if one looks only at the differences between the testers' data regarding referrals, major differences occurred between the testers. One source of the error may have been due to the different procedures used by the second tester in administering the test. On the second testing only one threshold was tested (far-point in one eye). This limited contact with the children may have interfered with the second examiner gaining rapport with the children. Some support for this hypothesis is found in that six of the eight disagreements (75% of the errors) on referral occurred with a higher score by the second tester (e.g., first test equals 20/30, second test equals 20/40). Additional information regarding potential tester bias is presented later in this report.

Results of Objective Tests

Three hundred sixty-five children were tested by professional eye examiners as described earlier. For the purpose of this study only the cycloplegic retinoscopy data were analyzed. This test yields a refractive error score measured in diopters of sphere and cylinder. Table VI presents the mean and standard deviations of the cycloplegic retinoscopy results. The reader should note that the retinoscopy examination yielded a distribution that was skewed to the positive on sphere scores (range = -5 to +7 diopters) and all cylinder scores were converted to minus scores (range = 0 to -3).

Table VI

Mean and Standard Deviations of the Cycloplegic Retinscopy by the Age Groups

	Right Sphere		Right Cylinder		Left Sphere		Left Cylinder	
Age (Mo.)	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
18-24	1.23	1.39	-.28	.65	1.25	1.42	-.32	.64
25-36	1.267	1.230	-.28	.50	1.34	1.32	-.28	.51
37-48	1.125	.95	-.29	.53	1.20	1.06	-.32	.57

Reliability of Cycloplegic Retinoscopy

Twenty-nine subjects randomly drawn from the original population received cycloplegic retinoscopy examinations by two different examiners to obtain data on inter-tester reliability of the refractive error data. The subjects' ages ranged from 18-42 months with a mean of 34 months. Since the refractive error assessment procedures independently assessed each eye, for the purpose of this reliability study, each eye was considered as a separate subject for a total of 58 data points.

Results

The analyses of the data for reliability are presented in Table VII. Pearson correlation coefficients were calculated for both the sphere and cylinder. The results yielded r's of .588 correlation on the sphere data and .367 on the cylinder data.

The vision professionals who obtained these data have stated that the procedures used for gaining refractive error data were somewhat gross due to the use of portable equipment; consequently, they expected

at least a .50 diopter error between testers. Therefore, Table VII also presents the percentage of agreement within a ±.50 diopter range. In addition, the data were also analyzed using the complete refractive error score to determine whether the examiners agreed on which subjects should or should not have been referred for a thorough examination. These analyses indicated that the examiners agreed on 86.7% of the subjects within the ±.50 diopter range as to referral or nonreferral.

Table VII

Cycloplegic Retinoscopy - Inter-Tester Reliability

	$\bar{X}$	SD	r	N	% Agreement (+/-.50 D)	Total Agreement
Sph. 1	1.17	.752	.588	58	70.7%	
Sph. 2	1.02	.955				86.7%
Cyl. 1	- .29	.477	.367	58	84.5%	
Cyl. 2	- .30	.352				

N = 29

Relationship of PVAT Scores to the Cycloplegic Retinoscopy Scores.

Three hundred forty-seven subjects, ages 18-48 months, were successfully tested by both the PVAT (threshold scores) and by the professional eye examiners to assess refractive error (cycloplegic retinoscopy examination procedures). As indicated earlier, the operational definition offered by the ophthalmological examination included children who should be referred based upon a cylinder score of -1.00 diopter or more (astigmatism), a spherical score of +3.00 diopters or more (hyperopia) or a spherical score of -1.00 diopter or more (myopia) in either eye. In addition, as indi-

cated by the reliability studies of the ophthalmological examinations presented earlier, the data were organized for purposes of this evaluation by using a $\pm$.50 diopter range for each score. A PVAT threshold score of 20/40 or greater was classified as a referral while a threshold score of 20/30 or less was classified as a nonreferral (subsequently modified, see page 27).

Table VIII presents the frequency of agreement and disagreement between the PVAT and retinoscopy referrals and nonreferrals by each age group. The results indicated that the PVAT and the retinoscopy examinations agreed as to those subjects classified as either referral or nonreferral on 78% of the subjects tested. The PVAT agreed with the retinoscopy examination as to referred subjects on 55% of the subjects and agreement with the retinoscopy examination on 60.8% of the nonreferred subjects. Nearly 4% of the total population were under-referred (i.e., retinoscopy scores indicated referral when PVAT indicated nonreferral), while 18% of the total population were over-referred by the PVAT.

Table VIII

Summary of the frequency of agreement and disagreement regarding those referred by retinoscopy examination (Cylinder -1; Sphere +3 or -1) with PVAT acuity score of 20/40 (N = 347)

	18-24 months		25-36 months		37-48 months		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
PVAT Referral	5	25%	72	49%	59	32.6%	136	39.2%
Agreement on Referral	4	80%	35	48.6%	36	61%	75	55%
Over-Referral	1	5%	37	25%	23	12.7%	61	17.6%
Under-Referral	2	10%	6	5.8%	6	3.3%	14	4%
PVAT Nonreferral	15	75%	74	50.7%	122	67.4%	211	60.8%
Agreement Nonreferral	13	86.6%	68	91.9%	116	95.1%	197	93.4%
Total N	20		146		181		347	
Total Agreement	17	85%	103	70.5%	152	84%	272	78.4%

To further analyze the relationship between PVAT and the retinoscopy examination the data were reorganized by increasing the criteria for referral of the retinoscopy examination to cylinder of -1.5, sphere of -1 or +3. These results are presented in Table IX. As can be seen by comparing Table VIII and Table IX this modification of the cylinder score did not appreciably change the agreement between PVAT referrals and retinoscopy referral.

Table IX

Summary of the frequency of agreement and disagreement regarding those referred by retinoscopy examination (Cylinder -1.5; Sphere -1 or +3) with PVAT acuity score of 20/40 (N = 347)

	18-24 months		25-36 months		37-48 months		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
PVAT Referral	5	25%	72	49.3%	59	32.6%	136	39.2%
Agreement on Referral	4	80%	33	45.8%	30	50.8%	67	49.3%
Over-Referral	1	5%	39	26.7%	29	16%	69	19.9%
Under-Referral	2	10%	6	4.1%	4	2%	12	4.5%
PVAT Nonreferral	15	75%	74	50.7%	122	67.4%	211	60.8%
Agreement Nonreferral	13	86.6%	68	91.9%	116	96.7%	199	94.3%
Total N	20		146		181		347	
Total Agreement	17	85%	101	69.2%	148	81.8%	266	77%

Further analyses were completed by modifying the criterion for PVAT referrals to 20/60. Table X and XI presents the results of this reorganization of the data. Table X presents a retinoscopy criteria of

cylinder -1; and sphere of -1 or +3 diopters and Table XI presents a criteria of cylinder -1.5 diopters with the sphere criteria remaining the same.

Table X

Summary of the frequency of agreement and disagreement regarding those referred by retinoscopy examination (Cylinder -1; Sphere -1 +3) with PVAT acuity score of 20/60 (N = 347)

	18-24 months		25-36 months		37-48 months		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
PVAT Referral	2	10%	28	19.2%	29	16%	59	17%
Agreement on Referral	2	100%	15	53.6%	16	55%	33	55.9%
Over-Referral	0	0%	13	8.9%	13	7.2%	26	7.5%
Under-Referral	4	20%	14	9.5%	15	8.3%	33	9.5%
PVAT Nonreferral	18	90%	118	80.8%	152	84%	288	83%
Agreement Nonreferral	14	77.8%	104	88%	137	90.1%	255	88.8%
Total N	20		146		181		347	
Total Agreement	16	80%	119	81.5%	153	84.5%	288	83%

Once again the modification of the retinoscopy criterion did not appreciably change the relationship between the PVAT and retinoscopy exam. However, a comparison of Tables X and XI with Tables VIII and IX indicates several differences. First, the rate of referral by the PVAT was substantively lower when using a 20/60 referral criterion (17% referral rate) than the 20/40 referral criterion (39%). This was further reflected in a lower rate of over-referrals (from 17.6% to 7.5%) and

slight increase in under-referrals (from 4% to 9.5%) when using 20/60 criterion. Agreement on referrals was not appreciably different between the 20/40 and 20/60 criteria.

Table XI

Summary of the frequency of agreement and disagreement regarding those referred by retinoscopy examination (Cylinder -1.5; Sphere 1.5 or +3.0) with PVAT acuity score of 20/60 (N = 347)

	18-24 months		25-36 months		37-48 months		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
PVAT Referral	2	10%	28	19.2%	29	16%	59	17%
Agreement on Referral	2	100%	14	50%	11	37.9%	27	45.8%
Over-Referral	0	0%	14	9.6%	18	9.9%	32	9.2%
Under-Referral	4	20%	11	7.5%	12	6.6%	27	7.8%
PVAT Nonreferral	18	90%	118	80.8%	152	84%	288	83%
Agreement Nonreferral	14	77.8%	107	90.7%	140	92.1%	261	90.6%
Total N	20		146		181		347	
Total Agreement	16	80%	121	82.8%	151	83%	288	83%

To further evaluate the validity of the PVAT the data were reorganized to determine the effectiveness of the two testers. Table XII presents the results of this data reorganization. The reader is reminded that earlier in this report the inter-tester reliability was presented. As indicated in that section there was concern regarding the low agreement on referral; even though the statistical analyses indicated that the agreement on total scores was highly significant. As can be seen in Table XII tester 1 accounted for a large percentage of the

Table XII

Summary of the frequency of agreement and disagreement between the PVAT and retinoscopy examination (Cylinder -1; Sphere -1 or +3) by each PVAT tester.

	18-24 months		25-36 months		37-48 months		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Referral								
Tester 1	1	10%	15	23%	17	25%	33	23%
Tester 2	1	10%	13	16%	12	11%	26	13%
Agreement								
Tester 1	1	100%	4	27%	8	47%	13	39%
Tester 2	1	100%	11	85%	8	67%	20	77%
Over-Referral								
Tester 1	0		11	17%	9	13%	20	14%
Tester 2	0		2	2%	4	3%	6	3%
Under-Referral								
Tester 1	2	20%	5	8%	3	4%	10	7%
Tester 2	2	20%	9	11%	12	11%	23	11%
Nonreferral								
Tester 1	9	90%	50	77%	52	75%	111	77%
Tester 2	9	90%	68	84%	100	89%	177	87%
Agreement								
Tester 1	7	77%	45	90%	49	94%	101	91%
Tester 2	7	77%	59	87%	88	88%	154	87%
Total Agreement								
Tester 1	8	80%	49	75%	57	83%	114	79%
Tester 2	8	80%	70	86%	96	86%	174	86%

disagreements between the retinoscopy examination and the PVAT as to referral. Of the 33 children referred by tester 1, 13 were in agreement and 20 were considered over-referrals or in disagreement with the retinoscopy examination. In other words 60% of the children referred by tester 1 were over-referrals. Tester 2 referred 26 children. Of these 20, 77% were correct referrals thus only 23% of the referred children were over-referrals. Agreement on nonreferrals was slightly in favor of tester 1 (91% to 87%). When viewing total agreement, tester 2 agreed with the retinoscopy examination on 86% of the cases while tester 1's results indicated an agreement on 79% of the cases.

Summary and Discussion

The results of this study have several striking similarities with the Taubenhaus & Jackson (1967) study. For example, when using the 20/40 criteria for referral, the agreement with the ophthalmological examination was 55% whereas Taubenhaus & Jackson found agreement on referral for various tests to range from 48 to 55%. The PVAT was in agreement with the ophthalmological examination on 61% of the nonreferrals while Taubenhaus & Jackson found a range of agreement of 41 to 55% agreement. Overreferral rates differed with the PVAT showing a 17.6% overreferral rate while the other study showed a low of 18% to a high of 52% overreferral rate. The PVAT underreferred 4%, as compared with the 11.2 to 18.5% underreferral rates reported by Taubenhaus & Jackson.

By increasing the referral score to 20/60 on the PVAT the agreement between the retinoscopy assessment and the PVAT referral increased to 55.9% while maintaining a low over- and underreferral rate (7.5% and

9.5% respectively). In addition, this criterion change also resulted in a drop of the referral rate from 39.2% to 17%. Additional modification of the referral criteria is discussed under Questions 4 and 5, below.

Considering the difference in ages between the subjects in the present study and those in Taubenhaus & Jackson study, the PVAT was more successful in achieving acuity screening of the younger children. The oldest subjects in the present study were equal in age to the youngest subjects in the Taubenhaus & Jackson study. Only one subject in the 37-48 month old group failed to complete the screening whereas Taubenhaus & Jackson indicate that approximately eight percent of their subjects were untestable. However, it should also be noted that the younger group (18-24 months old) accounted for 59% of the total untestable subjects in the present study.

The following section restates the original questions and provides a brief discussion of the results:

1. *What is the normal distribution of scores on the PVAT for preschool-aged children (18 to 48 mos.)?*

There was no significant difference between the various age groups as measured by their mean score on the PVAT. On the near point test a mean of approximately 20/30 was found for all groups. The mean for the 37-48 mo. group was slightly less than 20/30, yet these differences were very small. On the far point data the youngest (18-24 mo.) and oldest (37-48 mo.) children both had a mean of 20/33. The mean for 25-36 mo. subjects was slightly higher at 20/37. There was no systematic difference between the various age groups on their performance on the various threshold scores on the PVAT.

2. What is the normal distribution on cycloplegic retinoscopy or refractive errors for preschool-aged children (18 to 48 mos.)?

There was essentially no difference between the various age groups on mean scores of cycloplegic retinoscopy. Each group had a mean spherical score of approximately +1.25 diopters. The 25-36 mo. old subject had a very slightly larger mean refractive score and also performed slightly poorer on the PVAT test. The mean cylinder scores were approximately -.30 for all groups and did not differ significantly between the groups.

3. What is the inter-test reliability of the PVAT?

The inter-test reliability of the PVAT showed there was statistically significant agreement between the two testers at the .002 level. As previously discussed, the test/retest data suggest that the data were reliable, (93% agreement regarding referral) yet there was concern due to the differences found between testers regarding whether or not to refer a subject. Most of the disagreements between testers were a result of one tester fairly consistently obtaining poorer agreement with the retinoscopy examination as to referral (39% vs. 77%) yet the total agreement between the two testers and the retinoscopy examination (including nonreferral agreements) was adequate (79% and 86% respectively).

4. What is the relationship between the results of the PVAT and cycloplegic retinoscopy for preschool-aged children (18 to 48 mos.)?

The PVAT and retinoscopy examination agreed as to those subjects classified as either referral or nonreferral on 78% of the subjects tested using the 20/40 criteria. By changing the referral criteria from

20/40 to 20/60 the rate of overreferral was reduced with only a slight increase in underreferrals and resulted in 83% agreement for the combination of referrals and nonreferrals.

The present study had too few myopic subjects (N = 21) to allow an accurate evaluation of the use of the PVAT in identifying myopes in this age range. Further research with young myopic subjects is needed.

5. *Does the PVAT have predictive validity for making referrals for preschool-aged children (18 to 48 mos.)?*

The PVAT appears to reliably predict which students should be referred for further examination. The best predictor for this age group was a 20/60 or greater referral criteria for near point and a 20/60 or greater for far point acuity, following retesting.

In summary, the PVAT appears to have sufficient reliability and validity to serve as a visual acuity screening instrument for preschool children as young as 18 months of age. By using the recommended criteria for referral the PVAT produced few under- and overreferrals and agreed with retinoscopy examination at least as well as most preschool visual acuity tests.

Objective C. Disseminate the subjective visual acuity procedures to ten field-test sites throughout the nation.

Field-test Site Selection

The experimental vision screening procedures were field-tested in a variety of settings across the United States. Application forms, sample agreements, and an explanatory letter were mailed to potential field-test sites. Included in the list of potential sites were agencies which had expressed previous interest in becoming a site, projects listed in the current directory of Handicapped Children's Early Education Projects (HCEEP), state departments of education, and projects served by WESTAR, TADS, and PDAS, BEH-funded technical assistance projects. In addition, an advertisement was placed in the Newsletter of the Association for Severely Handicapped. Of the sixteen applications received, ten sites were selected on the basis of the following criteria:

1. Number of preschool handicapped children who were available for screening;
2. Geographic distribution of sites;
3. Types of handicapping conditions represented in available children; and
4. Type of program and service provided by the potential site.

An effort was made to select sites that reflected the full range of settings in which preschool handicapped children were served, and which included all types of handicapping conditions in order to adequately test the functional value of the experimental procedure.

Field-Test Workshops

A three-day format for up to ten participants was used with heavy emphasis on practicum experience. The format of each workshop was as follows:

Day I-a) instruction on general vision information

b) instruction on administration of pretest and threshold portions of the PVAT and administration of the Lighthouse test

short practicum with other participants

Day II-a) practicum with children using PVAT pretest and threshold

b) instruction on administration of discrimination training of PVAT

c) additional practicum with preschool handicapped children

Day III-a) practicum with preschool handicapped children using PVAT pretest, threshold, and discrimination training and Lighthouse test

Five test kits and five semi-automated devices were loaned to the ten participants at each site (one kit and one semi-automated device to each two participants). Participants agreed to screen at least ten preschool handicapped children within two months following their training and to return their screening results to the project. Each site coordinator agreed to follow up on each participant and to keep project staff informed of the progress of the data collection. As data collection was completed and sent to the project, each site and participant received certificates of appreciation and were requested to respond to a consumer feedback questionnaire by telephone.

A list of sites and dates of the workshops follows:

Fargo, North Dakota	August 24-25-26, 1981
Marshalltown, Iowa	September 17-18-19, 1981
Saratoga, New York	October 19-20-21, 1981
Akron, Ohio	November 2-3-4, 1981
Atlanta, Georgia	November 16-17-18, 1981
Tucson, Arizona	January 27-28-29, 1982
San Diego, California	February 1-2-3, 1982
Topeka, Kansas	February 8-9-10, 1982
Long Beach, Mississippi	March 3-4-5, 1982
Fort Wright, Kentucky	March 16-17-18, 1982

Two informal sites, New Zealand and Minnesota, were included in the field testing. Neither of these sites received the intensive 3-day training of the other ten sites. The two sites received a test kit on loan as well as a manual and demonstration tape. These sites provided information concerning the effectiveness of the manual and tape as well as the required child data.

A variety of agencies serving preschool handicapped children were represented. Examples of representative agencies were Headstart, public school preschool handicapped programs, private day-care programs, public school nursing services, private and public diagnostic agencies, United Cerebral Palsy Centers, public institutional settings for the handicapped and federally or state funded preschool handicapped projects.

Participants attending the workshop represented a wide variety of backgrounds and professions. Teachers of preschool children with

handicaps, school nurses, teachers of the visually impaired, diagnosticians, administrators and psychologists were among those who participated in the workshops.

The variety of preschool children who participated as subjects ranged from mildly handicapped children attending Headstart programs to severely multihandicapped children attending United Cerebral Palsy centers. Handicapping conditions ranged from children with mild speech impairments to those with severe retardation and/or physical impairments.

Field-Test Data Return

Ninety-two professionals participated in the three-day workshops. All of these persons agreed to screen ten preschool handicapped children and return the results to the project. Due to various problems twenty-three participants were unable to fulfill their obligation to the project. A total of 69 participants returned screening results on 635 preschool children. These subjects ranged from 13 to 184 months of age.

Results of the field-testing were evaluated in terms of the following:

1. The number of handicapped preschool children with whom screening was attempted;
2. The number who completed testing;
3. The number who required discrimination training;
4. The number who successfully completed discrimination training using the two errorless programs (see Objective A for description of the two programs);
5. The percent of referrals; and
6. The reinforcing items found to be most preferred, durable, economical, and easily obtained.

Field Test Results

Table XIII provides a description of the preschool-aged subjects who were initially included in the field testing of the preschool version of the PVAT. Screening was attempted on a total of 635 subjects from the ten field-test site locations. As expected, most of these subjects were categorized as mild or moderately handicapped and only a few were judged severely handicapped.

Table XIII

Description of the Total Sample of Children by Age and Severity of Handicap

	Handicap Unknown	Nonhandicapped	Mild	Moderate	Severe	Total
Age Groups:						
0-24 mos.	0	0	3	1	0	4
25-48 mos.	6	6	70	64	21	167
49-72 mos.	7	15	173	137	25	357
73-84 mos.	2	0	30	34	10	76
Over 84 mos.	0	0	6	19	4	29
Age not known	1	0	1	0	0	2
TOTAL	16	21	283	255	60	635

Table XIV provides a summary of those subjects who were eliminated from the field-test analysis. As can be seen, students who were not handicapped, too old (over 84 mo.), had incomplete data, or had no opportunity to perform on one or more of the components (pretest, discrimination training and threshold series) were excluded from further analyses.

Table XIV

Description of Children Eliminated From Total Sample by Reason for Elimination and Severity of Handicap

	Handicap Unknown	Nonhandicapped	Mild	Moderate	Severe	Total
Nonhandicapped	0	21	0	0	0	21
Over 84 months	0	0	6	19	4	29
Incomplete Data	16	0	49	38	12	115
No Opportunity	0	0	4	6	13	23
TOTAL	16	21	59	63	29	188

A total of 447 subjects were included in the final analysis. Table XV provides a summary of the number in each age group by severity of handicapping condition. As can be seen in Table XVI, 389 of these subjects (87%) were able to complete the threshold testing without discrimination training. An additional eight subjects successfully completed the discrimination training and threshold sequences. Thus 397 (88.8%) of all preschool handicapped subjects included in the field test were successfully screened on the PVAT.

Table XV

Description of the Number of Handicapped Children by Age and Severity of Handicap Included in the Final Analysis

	Mild	Moderate	Severe	Total
Age Groups:				
0-24 mos.	2	1	0	3
25-48 mos.	54	53	12	119
49-72 mos.	142	113	12	267
73-84 mos.	26	25	7	58
TOTAL	224	192	31	447

Table XVI

Description of the Handicapped Children Included in the Final Analysis Who Passed the Pretest and Completed Threshold Testing Without Training by Age and Severity of Handicap

	Mild	Moderate	Severe	Total
Age Groups:				
0-24 mos.	0	0	0	0
25-48 mos.	47	30	6	83
49-72 mos.	140	104	9	253
73-84 mos.	25	23	5	53
TOTAL	212	157	20	389

Table XVII shows the possible outcomes for subjects by frequency of subjects and severity of handicap.

Table XVII

Frequency of Subjects by Severity of Handicap at Different Steps in Obtaining PVAT Acuity Scores (Thresholds)

	Mild	Moderate	Severe	Total
Initially Began PVAT Screening	283	255	60	598
Eliminated from Study	59	63	29	151
Included in Final Analysis	224	192	31	447
Passed Pretest and Completed Threshold Testing	212	157	20	389
Failed Pretest	7	25	8	40
Entered Discrimination Training	7	25	8	40
Successfully Completed Discrimination Training	4	10	0	14
Gained Reliable Thresholds After Discrimination Training	3	5	0	8
TOTAL THRESHOLDS	215 or 96%	162 or 84%	20 or 65%	397 or 89%
Failed to Gain Appropriate Responses	4	9	3	16
Unsuccessful on Discrimination Training	3	15	8	26
Passes Pretest but Unable to Perform on Threshold	2	6	0	8
TOTAL UTP UNTESTABLE SUBJECTS	9 or 4%	30 or 16%	11 or 35%	50 or 11%

The original plan included a procedure for evaluating a number of discrimination training strategies. These strategies are described in Objective A. Since only 40 subjects attempted the discrimination training programs and only 14 completed this training, no conclusions could be drawn concerning the efficacy of the various programs (intensity fade, backup; intensity fade, representation; stimulus shape, backup; stimulus shape, representation). However, it is noteworthy that six of the ten subjects who were trained on the experimental stimulus shaping program using a backup procedure were successful as compared to one out of eight with the representation approach. On the intensity fading program, no differences between backup and representation approaches were noted.

Analysis of these data for referral and nonreferral of subjects is limited by the failure of the field testers to employ the recommended retest criteria as well as by the absence of ophthalmological data on the subjects. Based on first test scores, approximately 24% of the preschool subjects who could be tested had PVAT threshold scores which indicated that they were in need of further evaluation and should be referred using the referral criteria recommended in Objective B (20/60 on any threshold). About 20% of children with mild handicaps and 28% of those classified as having moderate and severe handicaps who could be tested had threshold scores which indicated that a comprehensive eye examination was needed. These data cannot be directly compared to other referral rates due to the lack of retesting of borderline scores. However, the referral rate found in the study described in Objective B, which involved preschool children without known handicaps, was 17% as

opposed to 24% for subjects with handicaps. These figures may represent a slight increase in the incidence of visual impairments in the handicapped preschool population, and seem to comfirm the findings with older handicapped persons that incidence of visual impairment increases with the severity of handicap. The absence of ophthalmological data on the field-test subjects' refractive errors prevents an analysis of the accuracy of these referrals and nonreferrals.

Comparison with New York Lighthouse Flashcard Test

As a secondary aspect of this study, the project also collected data for 235 field-test subjects on the New York Lighthouse Flashcard Test (Faye, 1968). There are a number of preschool "picture" acuity tests currently on the market. These tests are much faster and easier to use than is the PVAT. The rationale for including a "picture test" was to determine what percentage of the preschool subjects could perform on a "typical" picture test and thus not require the more time consuming procedures required by the PVAT. Secondarily we were interested in comparing the results of two tests that are designed to measure visual acuity.

A sample of 235 students from the field-test population were administered the New York Lighthouse Test, and 91 (39%) were able to complete the screening. Assuming there is a reliable and valid picture test on the market, one might assume that approximately 40% of preschool handicapped children could be easily screened and only 60% would require the PVAT. Of the 144 students who were unable to perform on the picture test, 111 (77%) were able to perform on the PVAT.

PVAT and Lighthouse data were available on 104 subjects. There was 62% agreement between these two tests regarding referral and nonreferral of subjects. These data suggest the need for additional research which would include ophthalmological data to determine the validity of each of these tests with the preschool handicapped population.

Results of Field-Test of the Semi-Automated Device

Participants were asked to indicate what reinforcing events they chose to use while administering the PVAT screening. Three categories of reinforcing events were possible: automated reinforcers using the semi-automated device (i.e., battery operated toys, tape recorders), manual reinforcers using hand delivered format (i.e., wind-up toys, edibles, praise) and a combination of automated and manual reinforcers. Data indicated that the automated reinforcers were used with 99 subjects. The manual reinforcers were used with 194 subjects and the combination of automated and manual reinforcers was used with 234 subjects. No information was available concerning reinforcers used for 18 subjects.

Since data were available on session lengths and total testing time per subject, a time analysis of the three possible reinforcement conditions was completed. Average session length and total testing time for automated reinforcers was 21.33 minutes and 48 minutes; for manually-delivered reinforcers 20.47 and 52.42 minutes, and for a combination of these two 20 and 62.40 minutes. The semi-automated device used alone showed a slight advantage over manual reinforcement, in increasing session length (less than one minute) and decreasing testing time (4.42 minutes).

In order to determine which of the two reinforcing events were most preferred, most durable, most economical, and most easily obtained the

project contacted participants by telephone near the conclusiong of the field testing. In response to the question concerning the participants' preference of reinforcing events, of the seventy-six contacted, half preferred the automated events and half preferred the manual events as reinforcers. However, the vast majority found the manual reinforcing events to be more durable, more economical, and easier to obtain than the automated reinforcing events. Since the use of the semi-automated device showed no clear advantage either from consumer feedback or child performance data, the project has chosen not to market the device as part of a preschool vision test procedure.

Objective D. Disseminate project information and identify and select marketing sources to make the materials commercially available.

Dissemination

The activities of this project have been shared with various audiences. Presentations were made throughout the grant period to disseminate information concerning the on-going work done by the project. The following include presentations made locally, statewide, and nationally:

Parsons Medical Society, 1979 - Vision Screening for Preschool and Handicapped Children

Kansas State Department of Education and Regents of the University, May, 1980 - The World of the Preschool Handicapped Child

Kansas State Department of Education, 1979, 1980 - Workshops in eight regions of Kansas--Medical and Educational Screening for the Child with Special Needs (Panel)

Labette Community College, Parsons, Nursing Department, 1981-82 Vision Screening of Infants and Preschool Children (Presented each semester to pediatric nursing class)

The Association of the Severely Handicapped National Conference, October, 1979 - Issues in Rural Service Delivery

The Association of the Severely Handicapped National Conference, October, 1980 - Evaluating the Visual Acuity of Preschool Handicapped Students

The Association of the Severely Handicapped National Conference, October, 1981 - Severey Handicapped Visually Impaired Students: Vision Screening, Low Vision Assessment, and Implications for the Practitioner

Kansas Association for the Education of Young Children, October, 1981 - Vision Screening of Preschool Children, Emporia, KS

International Conference of Ophthalmic Genetics and Pediatric Ophthalmology, San Francisco, CA, October, 1982 - The Parsons Test

In addition to these presentations the project has been the subject of articles which have appeared in several newspapers and newsletters. The following publications have released information concerning the project during its funding period:

The Parsons (Kansas) Sun

The Kansas City (Kansas) Star

Wyandotte (Kansas) West Newspaper

Parsons (Kansas) News

Moline (Kansas) Advance

Arkansas City (Kansas) Traveler

Howard (Kansas) Courant-Citizen

Dodge City (Kansas) Daily Globe

St. Marys (Kansas) Star

Weekend Prairie Drummer, Colby, Kansas

The Eskridge (Kansas) Independent

Goodland (Kansas) Daily News

The Topeka (Kansas) Capitol Journal

Natoma-Luray (Kansas) Independent

Chanute (Kansas) Tribune

Russell (Kansas) Record

Newsletter for the Association for the Severely Handicapped

Newsletter from TADS

Newsletter from WESTAR

Project staff wrote and submitted three professional journal articles. The authorship, title, and status of each article is as follows:

Cress, P. J., Spellman, C. R., DeBriere, T. J., Sizemore, A. C., Northam, J. K., & Johnson, J. L. Vision Screening for Persons with Severe Handicaps. Journal of The Association for the Severely Handicapped, Fall, 1981, 6 (3), 41-50.

Johnson, J. L., Spellman, C. R., Cress, P. J., Sizemore, A. C., & Shores, R. E. The school nurse's role in vision screening for the difficult-to-test students. The Journal of School Health (to appear in early 1983 issue).

Spellman, C. R., Johnson, J. L., Cress, P. J., Sizemore, A. C., & Shores, R. E. The development of a visual acuity test for persons with severe handicaps. The Journal of Special Education Technology (accepted with revisions).

Project staff assisted in preparing the following article:

Maino, J. H., Cibis, G., Cress, P., Spellman, C. R., & Shores, R. E. Noncycloplegic vs. cycloplegic retinoscopy in preschool children. American Journal of Ophthalmology (submitted).

Cibis, G. W. The Validation of the Parsons Visual Acuity Test. Ophthalmology (in preparation).

One additional document will be mentioned in connection with dissemination activity. Staff members Charles Spellman and Pamela Cress served on a task force formed by the Kansas Department of Maternal and Child Health which revised the vision screening guidelines used statewide. Project staff successfully advocated for the inclusion of provisions for screening

preschool and school-aged persons with handicaps, provided input in matters such as choice of screening tools and schedules for frequency of screening, and took primary responsibility for editing the resulting document. This document will be printed and disseminated to all school nurses and many public health nurses in Kansas.

Another form of dissemination resulted from the project staff's activity in providing inservice training, upon request, to relevant groups. The project has provided training (in addition to the field-test site workshops discussed in Objective C) to the following agencies:

Parsons, Kansas Kiwanis Club, 1980 - 5 members trained to conduct preschool vision screening;

State of Iowa Department of Public Instruction, April, 1981 - one day inservice training on vision screening for special education nurses from various regions in Iowa;

Bureau of Maternal and Child Health, Kansas State Department of Health and Environment, Southeastern district, October, 1981 - one day inservice training on vision screening for public health nurses;

Big Lakes Developmental Center, Manhattan, Kansas, March, 1981 - half day inservice training on vision screening for staff of preschool for the handicapped;

Department of Psychology, Emporia State University, March, 1981 - three-hour presentation on early identification of handicapping conditions;

Kansas State Department of Education, July, 1980 - five-day workshop on skills in Identification and Assessment of the Preschool Handicapped Child; and

South Central Regional Resource Center, Anchorage, Alaska, April, 1980 - a three-day workshop on vision screening of the severely handicapped.

The project also provided technical assistance to approximately 53 person in the form of telephone consultation and mailing of print material.

Perhaps the most effective dissemination of this research and development has resulted from the funding of two subsequent projects by the U.S. Office of Special Education. One of these, the National Inservice Training Project for Vision Screeners of the Difficult-to-Test, grant #G008102115, is engaged in preparing personnel throughout the nation to provide appropriate vision screening and follow-up to both preschool and school-aged persons with handicaps. To date 320 persons have participated in the training workshops provided by this project. Since many states already have vision screening systems for school-aged children, training in the use of appropriate tools is sufficient, in some cases, to ensure that students with handicaps are served. The problems of providing vision screening to preschoolers (including those with handicaps) are not as easily solved since most states do not have systems intact for such services. Thus, the newest project, Severely Handicapped Children: Statewide Program for Early Identification of Deaf-Blind Children, grant #G008202725, will develop workable systems for delivering screening services as well as conducting inservice training for screeners of infants and preschoolers. Both of these projects represent direct dissemination of the findings of the previous research to the field and attempt to maximize the utilization of these findings.

Marketing

Subsequent to the funding of this project the end product from the project for Research and Development of Subjective Visual Acuity Assessment Procedures of Severely Handicapped Persons, Bureau of Education for the Handicapped grant #G007602592, 1976-1979, was marketed by the Bernell Corporation, South Bend, Indiana under the title Parsons Visual Acuity Test. The project staff, LINC Services, Inc., and the Bernell Corporation are agreed that it seems most desirable to allow the Bernell Corporation to market the kit for preschool children with handicaps. Bernell has agreed to review all new material for possible marketing through their company. In the event that the Bernell Corporation chooses not to market a preschool version of the Parsons Visual Acuity Test, the principal investigator will contact the project officer and LINC, inc., for assistance in locating a different commercial outlet.

References

Barker, J., & Barmatz, H. Eye function. In W. K. Frankenburg and B. W. Camp (Eds.), Pediatric Screening Tests. Springfield, IL: Charles C. Thomas, 1975.

Cress, P. J., Spellman, C. R., DeBriere, T. J., Sizemore, A. C., Northam, J. K., & Johnson, J. L. Vision screening for persons with severe handicaps. Journal of the Association for the Severely Handicapped, 1981, 6 (3), 41-50.

Faye, E. E. A new visual acuity test for partially-sighted nonreaders. Journal of Pediatric Ophthalmology, 1968, 5, 210-212.

Forman, A. R. A new, low-concentration preparation for mydriasis and cycloplegia. Ophthalmology, 1980, 87 (3), pp. 213-215.

Kaakinen, K. A simple method for screening children with strabismus, anisometropia or ametropia by simultaneous photography of the corneal and fundus reflexes. Acta Ophthalmologica, 1979, 57, 161-171.

Mohindra, I. & Molinari, J. F. Near retinoscopy and cycloplegic retinoscopy in early primary grade school children. American Journal of Optometry and Physiological Optics, 1979, 56 (1), 34-38.

Stangler, S. R., Huber, C. J., & Routh, D. K. Screening Growth and Development of Preschool Children: A Guide for Test Selection. McGraw-Hill, 1980.

Taubenhaus, L. J., & Jackson, A. A. Final Report: Vision Screening of Three through Five Year Old Children. Brookline: Brookline, Massachusetts, Health Department, 1967.

Acknowledgments

The project is indebted to thousands of people (literally) who assisted its efforts. Numerous professionals provided helpful suggestions and advice to the project, including:

Dr. Victor Baldwin	Dr. James McLean
Dr. Robert Campbell	Dr. Joseph Maino
Dr. Gerhard Cibis	Dorothy Newman
Dr. Melanie Crandall	Cathy Rampy
Dr. Lois Dixon	Dr. Jack Richardson
Dr. Carol Foster	Dr. Murray Sidman
Dr. William Hart	Dr. Joseph Spradlin
Dr. Don Horner	Dr. Ron Taylor
Dr. Willard Jones	Dr. Anne Troutman
Dr. Theodore Lawwill	Dr. Hill Walker

The project also wishes to acknowledge the cooperation and assistance of the staffs of many daycare centers and preschools in southeast Kansas and the Kansas City area regarding objectives A & B of this report as well as the volunteers who helped with the mass ophthalmologic screenings in Kansas City. The ninety-two field-test screeners and the ten site coordinators provided invaluable assistance to our field-test efforts. Perhaps most important, the project wishes to thank the more than 1,000 preschool children, and their parents, who took part in the research. We couldn't have done it without them. To all others who aren't mentioned above, your help has been appreciated.

APPENDIX A

Revised Instuction Manual for
Parsons Visual Acuity Test

INSTRUCTION MANUAL

FOR

PARSONS VISUAL ACUITY TEST

FOR PRESCHOOL CHILDREN

This work was developed by the Bureau of Child Research, University of Kansas under grant #G007901961 with the Division of Innovation and Development, Office of Special Education, United States Office of Education. However, the content does not necessarily reflect the position or policy of OSE/USOE, and no official endorsement of the materials should be inferred.

INTRODUCTION AND RATIONALE

Visual acuity tests traditionally require persons being tested to read, label, or otherwise correctly discriminate between test targets of decreasing sizes. Thus the visual acuity threshold is the smallest test target that one can reliably identify. Since most standard visual acuity tests require complex receptive and expressive language skills and other learned behaviors, a large group of individuals, including handicapped persons and young children, have not been previously testable.

The Parsons Visual Acuity Test (PVAT) provides an alternative testing format and procedures which can be used with many children who are unable to perform on other visual acuity tests. Severely handicapped individuals and children as young as 18-months have been tested using the PVAT materials and procedures. [Please note that the PVAT should not be used with children who can perform on less time-consuming acuity tests. The PVAT is recommended for use only with children who fail to perform reliably on other acuity tests. Research has indicated that as many as 40% of handicapped preschoolers can perform on other visual acuity tests that require picture matching, such as the New York Lighthouse Flashcard Test.]

The PVAT consists of three major test components: pretest, discrimination training and threshold testing. The pretest is used to determine if the child understands the task and will reliably point to the hand. For those who fail the pretest the discrimination training programs are used to teach the responses required to complete the training. The third component of the PVAT is threshold testing. This is the actual acuity test used to determine the child's visual acuity threshold levels.

This manual has been designed to serve four functions:

1. Initial instruction on how to administer the PVAT. Please read it carefully to determine the appropriate steps for administering this test. The reader should become competent in using the test prior to actual screening of handicapped persons. Practice with adults or cooperative children until you can accurately administer the proper sequence of card presentation, record and interpret the data in the manner described, and deliver immediate reinforcement. To refresh your memory before testing, look over the section of the manual which corresponds to the test component you are administering.

2. Resource for problem solving: several sections of the manual contain suggestions which may be useful if problems arise in the test situation. Keep the manual with the test kit for easy reference.

3. Resource for information in the area of vision: how the eye works, common vision problems, and the total vision care process.

4. Recommendations for the follow-up role vision screeners should play to facilitate appropriate vision care.

MATERIALS

Bernell-O-Scope

The diagram on page 3 labels the components of the Bernell-o-Scope and provides instruction for assembly.

Stimulus Card Sets

Three sets of stimulus cards are included in the kit.

Threshold cards. These cards are used to test visual acuity. They include sizes from 20/20 to 20/250 with three cards at each size, numbered 1, 2, 3.

Pretest cards. This set includes three cards labelled 10-A/F, 10-B/D, and 10-C/E and show the three figures at full black intensity. By using the pretest cards the screener is able to determine whether the child can perform the discrimination needed to complete the threshold test.

Discrimination training cards. This set contains 27 cards numbered 1-9 with three cards at each step. Cards in the intensity fading discrimination program show the hand at full black intensity with the cake and bird appearing in gradually darker shades of gray throughout the program. The pretest cards serve as Step 10 in the discrimination program.

Match Card

Two 2 x 2 inch cards with a picture of the hand are included in the kit. A match card is used for the Identity Match portion of the Pretest and throughout testing if the match response is determined appropriate. The second match card is an extra in case one is lost or damaged.

Lenses

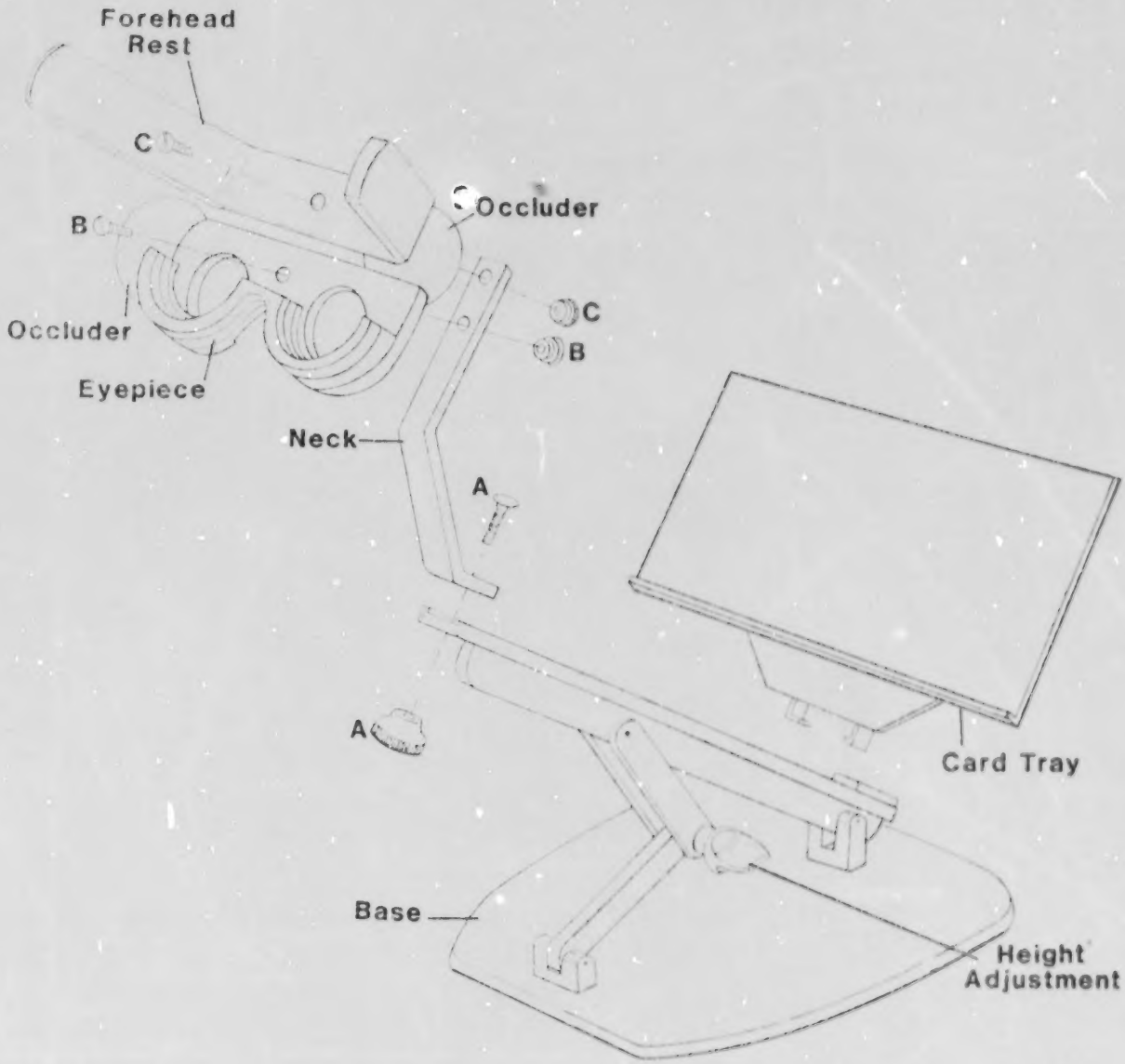
Two +3 diopter lenses are included and used for monocular far-point threshold testing. Only one lens is needed for testing. The second lens is provided as a replacement in case one gets scratched or broken. The screener places one lens in the groove closest to the eyepiece on the Bernell-o-Scope to simulate a 20-foot distance and adjusts the occluder to block the vision of the other eye.

Recording Forms

There are four forms included in the kit. The Pretest, Discrimination Training, and Threshold data sheets are used to record the person's responses for each component of the test. The Vision Summary is a form for use in summarizing and reporting the results of the vision screening.

Card Rack

A "W" shaped card rack is included to hold the set of cards being used. Two sets of tabbed cards are included to help organize the stimulus cards in the card rack. The tab cards labelled 1-10 are to be used with the discrimination training card set. The tab cards labelled 20/20-20/250 are used with the threshold card set.



Blow Apart Diagram

SELECTION OF REINFORCERS

Rationale

As used in this manual, a reward for correct performance is called a reinforcer. The purpose of using reinforcers is to indicate to the child that he has made a correct response and to increase the likelihood that the child will continue to perform the task and make correct responses. Therefore, it is important that items which the child likes be identified before testing with the PVAT. Various reinforcer selection procedures and sample reinforcers are described below. The purpose of each selection procedure is to discover what will motivate the child to perform consistently throughout testing.

Reinforcer Selection

Arrange three or four items in front of the child. If the items move or make noise, demonstrate each one, then ask the child which one he/she would like to see. The child may indicate by reaching or verbalizing his preference. Record the child's preference in the spaces provided on the upper righthand corner of the pretest data sheet. Change and/or rearrange the choices and repeat this process three to four times. If the child shows a preference (at least two choices to the same reinforcer) then proceed to the pretest using the preferred reinforcer.

If the child does not show a preference, but appeared to like several items, alternate between different items during the testing session. Alternating between items will frequently help maintain the child's interest in both the items and the task. After a few trials, the child may indicate a different preference by pointing or asking for a different item. The screener may also ask, "What do you want"?

An informal process for selecting reinforcers is to show the child an array of many items and let him pick three or four to be used during the testing session. Again, the child may want to change items after a few trials. Simply ask the child to select new items and remove the less preferred items from the testing table.

For children who show no preference or who are unable to indicate a preference, the screener may select several items and observe the child's reaction to each one. This can be done before testing begins by offering each food item or demonstrating what each toy does and observing the child's reaction to each choice. The screener can also combine reinforcer selection with the pretest by presenting a different reinforcer option after each trial of the pretest and observing the child's response. Careful observation of both the child's reaction and his level of performance should be indicative of the strength of the chosen reinforcers. If the child smiles or displays a favorable reaction to the toy and maintains a consistently correct performance level, the screener may assume the item is reinforcing.

Examples of Reinforcers

The following list of sample reinforcers have been used with the PVAT.

Edibles: Food items such as cereal, raisins, juice, and crackers may be used. NOTE: Caution should be used when giving edible reinforcers to some handicapped persons and small children. Information should be obtained regarding the person's eating skills before solid foods are given in order to avoid choking.

Wind-up toys: Small wind-up toys* such as "Not so Grand Band," "Flip Flops," and animals can be used. Wind-up toys can be used in different ways with young children to create a game effect. If a child seems to be tiring of a toy the screener should change toys or introduce a game to recapture the child's interest. Some examples of the games that can be played with wind-up toys are as follows:

Not So Grand Band Marchers march as a parade;
Toys walk to child or into child's lap;
Toys walk on Bernell-o-Scope base;
Toys pop-up from behind touchplate in the hand position;
Toys have races and/or run into each other;
Toys lay on their backs and side as if tired;
Toys walk on child's arm, hand, leg, neck, etc.;
Toys crawl into card rack and hide;
Toys tickle child's cheek with their feet;
Child stops the toy before it goes off the table;
Child winds-up the toy.

Music: A cassette tape recorder and tape of music can be used.

Vibration: A hand-held vibrator or vibrator pad may be used.

Air movement: A fan or hair dryer with the heating element removed may be used. Mobiles, balloons or streamers can be placed to move with the air flow. Extreme caution should be used to position or screen fans to prevent injury if the child reaches for the fan.

Physical contact: Pats, hugs, hair ruffling, may be used in combination with other reinforcers or alone. NOTE: Some children prefer not to be touched at all. Screener should carefully observe the child's reaction to this type of reinforcement.

Verbal Praise: Verbal praise such as, "Good boy, You're doing a good job," is most effective when used in combination with other reinforcers.

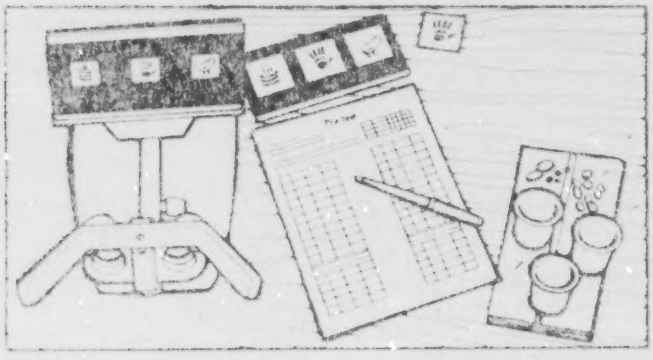
Several consecutive incorrect responses and refusal to perform may indicate that new reinforcers need to be tried. The screener must be aware of these occurrences and change reinforcing events when necessary. It also may be necessary for the screener to run a new preference test before each session to be certain that the child is still interested in the reinforcers.

*Wind-up toys such as those described are manufactured by the Tomy Corporation, Carson, CA.

There will be some children for whom it is very difficult to find an effective reinforcer. The screener should be certain that every reasonable option is tried. Sometimes parents or teachers can give suggestions to the screener. Admittedly, there may be a few children who simply will not cooperate in the testing session. If the screener has tried many options and is still not successful in gaining the child's cooperation, a functional vision assessment should be attempted. In some cases it is beneficial to postpone screening for a few months and then try again. If acuity testing cannot be completed within a few months due to lack of cooperation or failure to learn in the PVAT discrimination training program, the child should be referred for a professional eye examination if he/she has not had such an examination within the last one or two years.

Rationale

A pretest is given to determine if the student can reliably discriminate one of the forms on the test cards. If the student can discriminate one of these forms, he/she is ready for threshold testing. If the student does not pass the pretest, he/she must be taught to make the discrimination. Later, sections of this manual describe various procedures to be used with the students who do not pass the pretest. (See Discrimination Training, p. 15.) There are six pretest formats, labelled 10-A/F, 10-B/D, 10-C/E on the front of the cards.



Materials

1. Various edible reinforcers
2. Pretest data sheets
3. One set of Pretest Cards (6 formats on 3 cards, labelled 10-A/F, 10-B/D, 10-C/E)
4. A match card of the hand figure (for use with Identity Match Pretest)
5. A box of tissues or a damp cloth for clean-up
6. Paper cups
7. Pencils

Procedure

1. Fill in spaces at the top of the pretest data sheet (p. 9).
2. Position the student with forehead on the headrest and hands in lap.*

Auditory-Visual Pretest

3. Trial 1

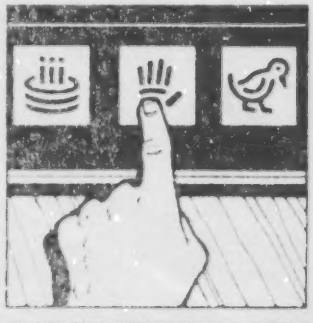
   a. Place the pretest Card A in card tray. Say, "Show me hand."

   b. Trainer responds to student behavior in the following ways:

      1. Independent correct response is reinforced.
      2. Independent incorrect response is followed by this correction procedure: Trainer says, "No, here's the hand," while assisting the correct response. No reinforcer is delivered for any incorrect responses.
      3. No response within three to five seconds is followed by a physical assist. Take the student's hand and assist him/her to point with index finger to the hand. The point should touch the card inside the white square background of the figure. Reinforce physically assisted responses for the first three trials.

   c. Record results on data sheet. Put an "H" in choice column for correct response. Circle the "H" to indicate a physiclaly assisted trial. Indicate errors in position column. Position of error responses should be noted in the position column (see sample pretest sheet, page 9). It is not necessary to record the position of correct responses, since the data sheet has the correct position listed for each card.

A correct pointing response occure when the fingertip is touching inside the white background of the figure. Cannon incorrect points are to the side of, or below the figure. Student should be trained, if necessary, to make a correct pointing responce.



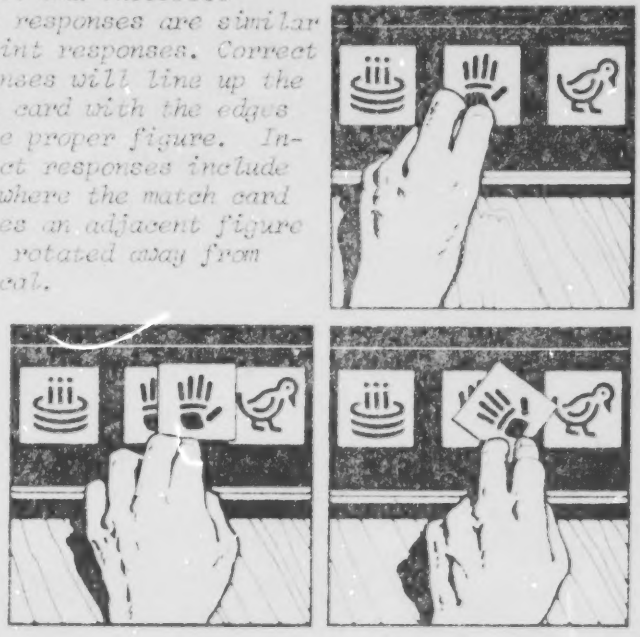
*Adjust the headrest to the correct height for the child, and attach the eye piece which best matches the pupillary distance for each child. (There are two in each kit.)

4. Trial 2
   a. Put card B in the card tray. Say, "Show me hand."
   b. Trainer responds to student behavior as in Trial 1.
5. Trial 3 Card C, "Show me hand." Same as above.
6. Trial 4 Card D, "Show me hand," reinforce correct response. After three to five seconds provide physical assistance but do not reinforce assisted responses. Say, "You do it." (Some students would never initiate a response if physical assists resulted in continuous reinforcement.)
7. Trials 5-9 Card E,F,F,E,D. Continue as in Step 6.
8. Compile results. Use the following guide to decisions at this point.
   a. If the student scored 8 out of 9 or better for unassisted correct responses, go to Threshold Testing on page 10.
   b. If the student required more than one assisted trial and makes at least 4 unassisted correct responses in trials 5 through 9, continue with the same pretest until he/she has 8 out of 9 correct.
   c. If the student makes two or more error responses or required assistance throughout pretest, move to the Identity Match Pretest (step 9, below).

Identity Match Pretest

9. Put card A in the card tray. Using the (2" x 2") match card in the pretest set, demonstrate the matching response of placing the card on the hand. (If the student is familiar with the matching response this demonstration may not be required.)
10. Place the match card in the student's hand and say, "Show me hand."
11. Repeat steps 3 through 8 in Auditory-Visual.
12. Compile results. Use the following guide to decisions at this point:
    a. If the student scored 8 out of 9 or better for unassisted correct responses, go to Threshold Testing (see page 10).
    b. If the student required more than one assisted trial and made at least 4 unassisted correct responses on trials 5 through 9, administer same pretest to meet the 8/9 criterion.
    c. If the student made two or more error responses or required assistance through the pretest, go to Discrimination Training, page 15.

Correct and incorrect match responses are similar to point responses. Correct responses will line up the match card with the edges of the proper figure. Incorrect responses include ones where the match card touches an adjacent figure or is rotated away from vertical.



13. Modifications of test response. Students with orthopedic handicaps may require a modification of the required response for testing. Existing responses such as yes-no head nod, foot tap, or other measurable response can be substituted for a point or match response. The test is then administered by having the screener point to each picture and asking "Is this the hand?" .

Date 9/15

Name SUSAN SMITH

Tester P. CRESS

Comments

Pretest

Trial 9

	reinforcer	1	2	3	4	5
1	juice			X		X
2	peanut	X	X			
3	raisin				X	
4	CRACKER					

Auditory-Visual

Trial	Card	Choice	Position
1	A	(H)	2
2	B	H	1
3	C	H	3
4	D	B	1 / 2
5	E	C	3 / 2
6	F	(H)	2
7	F	B	2 / 3
8	E	C	3 / 2
9	D	H	1

Stop here: Total 3/9

	A		2
	B		1
	C		3
	D		1
	E		3

Identity Match

Trial	Card	Choice	Position
1	A	(H)	2
2	B	H	1
3	C	H	3
4	D	H	1
5	E	H	3
6	F	H	2
7	F	H	2
8	E	H	3
9	D	H	1

Stop here: Total 8/9

	A		2
	B		1
	C		3
	D		1
	E		3

THRESHOLD TEST

Rationale

Once the student meets the criterion of 8 correct responses out of 9 on the pretest, he/she is ready for Threshold Testing. Threshold testing determines the smallest size which can be discriminated. This size is the student's visual acuity threshold. Threshold testing is administered at two distances--near point (NP) at 13" and far point (FP) at a simulated 20 ft. distance using a +3 diopter lens at 13". For those screeners who have difficulty distinguishing the correct figure on the smaller threshold cards, labelling the back of the card as to the position of the hand will eliminate this problem.

Materials

1. Various edible reinforcers
2. Threshold data sheets
3. One +3 Diopter Lens
4. One set of Threshold Cards (24 cards. 20/20-20/250)
5. Card rack
6. A box of tissues or a damp cloth for clean up
7. Pencils
8. Paper cups
9. Match card for students who passed Identity Match Pretest.

Procedure

1. Arrange cards in descending order in back section of card rack. Place the 3 cards of each size behind their respective tab card, with card 1 in front. Once a card has been presented it should be returned to the back of the group for that size, which "sheffles" the cards at each size. As a correct choice is made, the tab card and cards for that size can be moved to the front of the card tray so that the size to be presented next is always visible to the screener.

2. Fill in spaces at the top of threshold data sheet (see sample, page 12).

Near Point Testing (Binocular)

3. Trial 1 (test both eyes)

   a. Place card "1-20/250" in card tray.
   b. Say, "Show me hand."
   c. Reinforce correct responses. Do not use the correction procedure (p. 7) during Threshold testing; instead, say, "Let's try another one."
   d. Record "+" for correct and "-" for incorrect. (If response to Trial 1 is incorrect, see Unreliable Responding, p. 14.)

4. Trial 2

   a. If Trial 1 response is correct, present card "1-20/125";
   b. Say, "Show me hand."
   c. Reinforce correct response.
   d. Record "+" or "-".

5. Remaining trials--Proceed as follows: Each correct response is followed by a trial at the next smaller size; each incorrect response is followed by a trial at the next larger size. This procedure should be followed throughout the remainder of the testing until a threshold has been determined (see Determining Thresholds, Step 6). At the 20/20 size, if a student makes a correct response, present another 20/20 trial.

6. Determining thresholds: Most students will supply data such as is seen in Example 1 and will score four or more correct on the 20/20 cards. A score of 4/6 correct on one line with less than 4/6 correct on the next smaller line should be called the threshold (see examples 2 and 3). Example 4 shows Unreliable Responding. A student whose data looks like this should be retested. Some parts of the test may be repeated to pinpoint the threshold when Unreliable Responding has occurred. Record the scores on the threshold data sheet (see sample form, page 12) and on the vision summary form (see sample form, page 13).

Example 1 **20/20**

20/250	+					
20/125	+					
20/100	+					
20/80	+					
20/60	+					
20/40	+					
20/30	+					
20/20	+	+	+	+		

Example 2 **20/40**

20/250	+					
20/125	+					
20/100	+	+				
20/80	–	+				
20/60	+	+				
20/40	–	+	+	+	+	
20/30	–	+	–	–		
20/20	–					

Example 3 **20/80**

20/250	+					
20/125	+					
20/100	+					
20/80	+	+	+	+		
20/60	–	–	–			
20/40						
20/30						
20/20						

Example 4 **Unreliable**

20/250	+	+	–	+	–	
20/125	+	+	–	–	+	–
20/100	+	+	–	+	–	–
20/80	+	–	+	–	+	–
20/60	–	+	–	+	–	
20/40	+	–	+	–		
20/30	–	+	+	–		
20/20	–	–				

7. Adjust the right occluder to occlude vision in the student's right eye and proceed as in steps 3, 4, 5 and 6, testing the vision of the left eye.
8. Adjust occluder to occlude the left eye and test the vision of the right eye.
9. Allow a short break from testing. Be alert for Unreliable Responding (p. 14), realizing that some students should complete testing at a different session.

Far Point Testing (Monocular)

10. With +3D lens in place in headrest groove closest to the eye, follow procedures of near point testing, Steps 3 through 8, for left and right eye (do not test with both eyes). Inspect the lens frequently for dirt and smears, and clean as often as necessary.
11. It is recommended that students who score 20/40 or 20/60 on any of the five threshold tests should be re-tested. If the retest scores remain 20/40 or worse the student should be referred for a professional vision examination. Students who score 20/80 or worse on their first test can be referred without retesting. Any student whose scores for each eye separately are different by two or more lines should be referred.

The developers of this test determined that due to the format, arrangement, and spacing of these test targets, the actual size of the test targets must vary from the targets used in standard charts. The size labels used for this test have been adjusted so that scores obtained correspond to scores from standard tests.

Threshold

Name SUSAN SMITH

Date 9/15/79 Correct Figure

N.P. (Both)

20/250	+					
20/125	+					
20/100	+					
20/80	+					
20/60	+					
20/40	+					
20/30	+					
20/20	+	+	+	+		

N.P. (Left)

20/250	+					
20/125	+					
20/100	+					
20/80	+	+				
20/60	—	+				
20/40	+					
20/30	+					
20/20	+	+	+	+		

F.P. (Left)

20/250	+					
20/125	+					
20/100	+					
20/80	+					
20/60	+					
20/40	+					
20/30	+	+				
20/20	+	+	—	+	+	

N.P. (Right)

20/250	+					
20/125	+					
20/100	+					
20/80	+					
20/60	+					
20/40	+					
20/30	+	+				
20/20	—	+	+	+	+	

F.P. (Right)

20/250	+					
20/125	+					
20/100	+					
20/80	+					
20/60	+					
20/40	+					
20/30	+	+	+			
20/20	+	+	—	—	+	+

VISION SUMMARY

Susan Smith — Birth Date 10/10/69

's Name John L. Smith

's Address 1711 Grand

of last eye examination by Ophthalmologist or Optometrist 10/78

History glasses ____ cataract ____ coordination ____ Other ____ (Specify)

To Be Completed By Screener

ual Acuity
Near point R.E. 20/20 L.E. 20/20 B 20/20
Far point R.E. 20/20 L.E. 20/20

ening with glasses ____ without glasses X

procedure used Parsons Visual Acuity Test (PVAT)

ments on testing very cooperative, likes orange juice for reward

ptoms of Visual Difficulty (include behavior, appearance, or complaints) none

ommendations
ral ____
referral X
r (Specify) ____

Pamela Cress
Signature of screener

Date 9/15/79

To Be Completed By Ophthalmologist or Optometrist

al Acuity

Near point	without lenses	R.E. ____	L.E. ____	B ____
	with lenses	R.E. ____	L.E. ____	B ____
Far point	without lenses	R.E. ____	L.E. ____	
	with lenses	R.E. ____	L.E. ____	

ractive Error R.E. ____
L.E. ____

minations ____

ance ____

gnosis ____

e glasses prescribed: yes ____ no ____

ses should be worn: all the time ____, for close work only ____, for distance only ____

er recommendations ____

Signature ____

Date ____

Date of return visit ____

BEST COPY AVAILABLE

Unreliable Responding

The most frequent causes of unreliable and inconsistent responding during threshold testing are weak reinforcers and sessions which are too long. When these occur, discontinue session for at least thirty minutes; then, administer another reinforcer preference test, introducing new choices, and shorten session length by 10 or 15 trials.

Other reasons for unreliable responding include:

1. Fatigue, especially during far point test. It is common for persons reading small print to experience a temporary blur. If more than three errors occur consecutively with a student whose performance has been reliable, allow a little more time between trials for looking around at various distances.

2. Selecting only one of the three positions. Check for a position bias by readministering pretest.

3. Guessing. Students will guess correctly on some trials so that some of the data may indicate better vision than is actually the case. Administering a second Threshold Test should minimize the effects of this. An interval of at least thirty minutes should separate threshold tests; for some students, this interval should be considerably longer. Begin each new session with a reinforcer preference test.

Discrimination Training

Rationale

For persons who cannot meet criteria on any of the pretests, it will be necessary to train the discrimination. A set of cards is provided for training the hand discrimination using an errorless intensity fading procedure.

If a student does not perform 8/9 correct on one of the pretests, has a position preference, or shows repeated unreliable responding, use the Discrimination Training Program.

Materials

1. Various edible reinforcers
2. Discrimination data sheets
3. One set of discrimination cards (27 cards numbered 1-9, 3 at each intensity)
4. Card rack
5. A box of tissues or damp cloth for clean-up
6. Pencils
7. Paper cups
8. Match card

Procedure

1. Arrange cards in card rack. Place the 3 cards of each intensity in separate groups.
2. Using the data sheet provided, fill in the spaces at the top (See sample, p.17)
3. Conduct reinforcer preference test (p.4) and record results.
4. Use the sequence provided on the data sheet for the position of the hand figure; left, middle, or right.
5. Trial 1
   a. Present card 1 (hand only) with the hand in the left position.
   b. Say, "Show me hand." If no response is made within 3 to 5 seconds, physically assist the student to point with the index finger to the hand. The point should touch the card inside the white square background of the figure. (Pretest data may indicate that the student should use the match response instead of the point. (See pretest, page 7.)
   c. Reinforce both independent and assisted correct responses.
   d. Record results on data sheet. Place X in the position actually chosen. Circle the X to indicate an assisted trial (See example data sheet, p. 17.)
   e. If an error response occurs, say, "No, here's the hand," assisting the correct response. See correction procedure under Pretest Procedure Step 3, p. 7. Do not reinforce a corrected response.
6. Trial 2
   a. Present card 1 with the hand in the middle position.
   b. Say, "Show me hand." If no response in 3 to 5 seconds, assist the correct response.
   c. Reinforce independent and assisted correct responses. Record results as in 5d.
   d. Use correction procedure for an error response as in 5e.
7. Trial 3

   Present card 1, right position. Proceed as in Step 6 above.
8. After three trials with card 1, use the following guide to decisions at this point:
   a. If the student made 3 independent, correct responses, proceed with card 2, right position.
   b. If the student required assistance or correction on any of the first 3 trials, continue with card 1 in the indicated sequence until the student performs 3 independent, correct responses consecutively. Then proceed as in 8a.
9. If no errors occur, proceed through cards 2-9, presenting 3 trials at each intensity level. Sample data sheet Session #1 illustrates this type of responding (p. 17). Then, proceed to the appropriate pretest, card 10-A

10. If an error response occurs, use the correction procedure (see 5e) and present as the next trial a card of the next lower number, where 3 correct responses have occurred. (See sample data sheet, Session #2, p. 17, trials 11-12 and 25-26.) Circle the trial number when an error occurs. Three correct responses must occur to proceed to the next numbered cards.

11. If four errors occur, present a card 1 to finish with a correct response and terminate the session. At a separate session, begin with card 1 and repeat procedure. Begin each session with a reinforcer preference test (see p. 4).

Discrimination Training

Date 9/15

Name Susan Smith

Trainer P. Cress

Session Number 1

Trial	Intensity				
1	1	L	⊗		
2	1	M		X	
3	1	R			X
4	1	R			X
5	2	L	X		
6	2	M		X	
7	2	R			X
8	3	L	X		
9	3	M		X	
10	3	L	X		
(11)	4	M			X
12	3	R			X
13	3	M		X	
14	3	L	X		
15	4	M		X	
16	4	R			X
17	4	R			X
18	5	L	X		
19	5	L	X		
20	5	M		X	
21	6	R			X
22	6	M		X	
23	6	R			X
24	7	L	X		
(25)	7	L		X	
26	6	M		X	
27	6	M		X	
28	6	R			X
29	7	L	X		
30	7	R			X

Session Number 2

Trial	Intensity				
1	1	R			X
2	1	M		X	
3	1	R			X
4	2	L	X		
5	2	L	X		
6	2	M		X	
7	3	M		X	
8	3	R			X
9	3	L	X		
10	4	L	X		
11	4	M		X	
12	4	R			X
13	5	R			X
14	5	M		X	
15	5	L	X		
16	6	L	X		
17	6	R			X
18	6	M		X	
19	7	M		X	
20	7	L	X		
21	7	L	X		
22	8	R			X
23	8	M		X	
24	8	R			X
25	9	R			X
26	9	L	X		
27	9	M		X	
28	Go	R			
29	to	L			
30	PreTest	M			

Continuing Errors

For those students who continue to make errors after three or four sessions, certain decisions must be made:

1. There are students who will require training for the point response itself, or other test behaviors, such as sitting in a chair, or looking at the cards. Since these behaviors are required for many educational and vocational tasks, it may be necessary to train these behaviors.

2. For those students who may have the necessary test behaviors yet continue to make errors, researchers are developing additional "back-up" programs for training the discrimination. Additional "back-up" programs will be available by 1983.

3. If visual acuity testing is not completed by a student within a reasonable time (1-2 months), it is recommended that the student be referred for objective tests, particularly if the student has not had a recent eye examination.

Prescription Confirmation and Treatment Monitoring

The next stage in the process of vision care is to refer children with suspected visual impairments to an ophthalmologist or optometrist for a thorough evaluation. The standard eye examination includes visual acuity testing, followed by objective tests involving the use of various instruments to determine the physical characteristics of the child's visual system. These objective tests can be performed without requiring a response from the person being tested. The results of this examination determine what treatment is needed to correct the visual impairment.

The most common vision problems are refractive errors, including myopia, hyperopia, and astigmatism (see glossary, p. 20). These can be treated with prescription lenses. The eye examiner obtains an estimate of the strength of the needed lens through objective procedures. Typically, this prescription is then confirmed or modified by conducting a subjective visual acuity assessment while the person wears the tentative lens correction. This process of prescription confirmation is critical to providing adequate vision care, as it verifies that the lens correction results in improved vision. Since handicapped children have not been able to perform on standard acuity tests, lenses have been prescribed for them without confirmation of the effectivness of the treatment.

The threshold testing procedures described in this manual can be used to confirm or modify a lens prescription prior to the actual purchase of the lenses, with the cooperation of a professional eye examiner.

Following the objective examination, a tentative lens prescription is determined by the eye examiner. Using trial frames and trial lenses (equipment which can be purchased for this purpose or borrowed from the eye examiner), these glasses can be "built" to specification and another threshold test administered with the correction in place. Results of this testing will indicate the effectiveness of the prescription in alleviating the impairment. A series of such tests may be administered at the request of the eye examiner to determine the most effective correction for an individual, prior to the actual purchase of glasses.

Some visual impairments are properly treated with surgery, eye patching, orthoptic exercise, or other techniques. Such
trea treatments are most effective when performed at an early age. The treatments should be monitored through frequent acuity testing and objective examination to allow decisions regarding treatment to be data-based, and therefore, maximally effective. If these visual acuity test procedures become widely used, handicapped persons will have access to much more reliable vision care services.

Visual acuity testing can also provide information regarding the functional vision of persons with uncorrectable visual impairments. Threshold scores for such individuals indicate the smallest size stimuli which can be discriminated, and can be used to develop educational programs utilizing appropriate stimulus materials for each individual.

Glossary

Although the reader need not become an expert in vision to detect possible vision problems, many professionals who work with young children could benefit from understanding diagnoses of detected impairments. To assist the reader in deciphering vision reports, a glossary of common vision terms is included here.

amblyopia: a common visual impairment, affects an estimated 7% of the population. It is commonly referred to as "lazy eye", although this is an inaccurate description of the problem. This condition occurs when there is considerable difference between the two eyes of an individual. If uncorrected, amblyopia may lead to irreversible blindness of the weaker eye. Amblyopia can be detected by conducting subjective visual acuity tests with each eye separately. Amblyopia may also result from an imbalance of the eye turning muscles. Many amplyopes are not presently identified in time for treatments to be maximally effective.

blepharitis: infection in the margin of the eyelids.

cataract: opaque condition in the normally clear lens inside the eye.

conjunctivitis: inflammation of membrane that lines the eyelids.

diopter: unit of measurement for strength of corrective lenses.

diplopia: double vision.

nystagmus: a rhythmic vacillation of the eyes. May be intermittent or constant.

objective tests: examinations of the eye's internal and external structure as well as the optical error are conducted by optometrists or ophthalmologists. No response is required of the person being examined. Such tests include the use of the ophthalmoscope and the retinoscope.

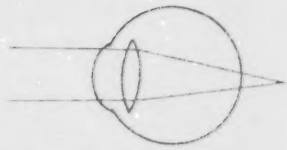
phoria: A latent imbalance of the eye turning muscles. Esophoria is a tendency for the eyes to cross. Exophoria is a tendency for the eyes to diverge and hyperphoria is a tendency for one eye to turn above the other.

ptosis: a paralytic drooping of the upper lid.

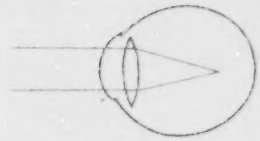
Refractive errors:

astigmatism: the rays of light from a point do not focus as a point because the surfaces of the cornea or lens are not spherical.

hyperopia (far sightedness): a defect of vision caused by the lack of sufficient refractory power to focus parallel rays of light from distant objects on the retina. Corrected with a plus (+) spherical lens.



myopia (near sightedness): the vision is increasingly blurred as distance from target increases. Caused by image focused in front of the retina. Corrected with a minus (−) spherical lens.



tropia: (syn strabismus, heterotropia) imbalance of the eye turning muscles. May be esotropia, exotropia, hypertropia, monolateral, or alternating.

WHAT IF....?

Problems with Initial Responding & Pretest

What if the child does not make a point response?

Present the match card alone and first demonstrate the pointing response, then physically assist the child to point to the hand on the match card. Reinforce the child for successive approximations of touching the hand (i.e., first allowing you to physically assist a point response, then pointing after you provide a model). Using the Bernell-o-Scope when training an initial response is not necessary. Rather, the screener may simply hold the match card in one hand during this training. Step 1 discrimination training cards can also be used when training this initial response to the hand.

What if the child will not look through the Bernell-o-Scope?

In order to familiarize the child with the equipment, the screener can try to make a game out of looking through the eyepiece. The screener should demonstrate. Children may be encouraged to play "peek-a-boo" games, "looking through the window," etc. The touchplate may be removed so the screener can look back through the scope at the child. Small toys and other reinforcers may be used to encourage the child to look through the scope. For example, place a preferred toy on the Bernell-o-Scope or have the reinforcer pop out from behind the card tray. If the child is resisting use of the equipment, reinforce any movement toward the Bernell-o-Scope. Sometimes it may be necessary to have the equipment to the side or away from the child's line of vision when the first session begins. The equipment can then be gradually introduced as the child becomes comfortable with the testing environment.

The pretest and discrimination training can be conducted without using the Bernell-o-Scope. The screener may hold the card, lay the card flat on the table or lean the cards against an upright surface. The eyepiece and neck of the Bernell-o-Scope may also be removed so that the cards may be presented on the card tray without requiring that the child look through the eyepiece. Many times it is preferable to insure that the child understands the task and will consistently point to the hand before requiring use of the Bernell-o-Scope.

What if the young child will not stay in the chair?

A highchair can be used to help keep the child at the test station. Remove the tray and place the highchair at an adult-height table or if the highchair tray is large enough, the Bernell-o-Scope can be placed on the tray with the other equipment and materials on another table. With some children it may be helpful to have the mother or a person the child is familiar with hold the child on their lap and encourage the child to respond. Be careful that the mother does not interfere with the testing situation. Some children will work better when their mother is not present.

What if the child does not have any operant response?

Functional vision screening should be done and the child should be referred for a professional eye exam if he has not had one within the last year.

What if the young child cannot reach the cardtray to make a response?

A primary size pencil can be used as a pointer. Pens, dowel rods, or other items may also be used to enable the child to touch the cardtray. If a match response is being used the match card can be attached to the end of the pointer so that the child will see the hand on the match card when responding.

What if the child touches the black area outside of the white boxes?

The screener must be able to clearly distinguish between correct and incorrect responses. However, some young children, especially those using a pointer, may not have the fine motor coordination necessary to hit exactly where they are looking. If a child touches the black area then moves into one of the white boxes, the stimulus touched first should be considered the response. Do not allow a child to change his response by pointing to more than one box.

What if the child turns the small match card sideways or upside down when making a match response?

The orientation of the hand on the match card is not critical as long as the match card doesn't touch more than one of the stimuli.

What if the child has difficulty holding and manipulating the match card?

The card can be glued to a small wooden block to increase the thickness. If the child also has difficulty reaching the cardtray the match card can be attached to one end of a pointer. Be sure the picture of the hand is facing the pointer so it will be visible to the child when making a response.

What if during pretesting the child consistently points to the cake or the bird?

If the child consistently points to the cake or bird that figure can be used for threshold testing. If the bird is used it is probable that you will obtain scores one line better than if you are using the hand target.

What if during pretesting the child shows a preference for responding to one position?

Sometimes using the discrimination training program will teach the child to respond to the hand because the other figures appear gradually and the child has an opportunity to be reinforced for pointing to other positions. A position bias may be overcome by providing full physical assistance of correct responses followed by reinforcement. This technique

should employ Step 1 training cards in the predetermined random sequence. You may try having the child scan the entire card by pointing to each picture individually and instructing the child to look at the picture you are pointing at. You may also begin Step 1 of the discrimination program with the cards displaying the hand in the preferred position removed. The previously preferred position should be reinstated into the training program as soon as the child demonstrates a shifting of responses to the hand figure in the previously nonpreferred position. Continuing to omit training cards with the hand figure in the preferred position could result in the child shifting to another position but still not attending to the relevant variable (the picture of the hand). When a strong position preference exists the screener must be alert to it and make clinical judgments about strategies to eliminate the biased responding.

Problems During Discrimination Training & Threshold Testing

What if the child is making progress in the discrimination program, but appears to get tired of the task before the entire program is presented?

Decrease the number of trials by presenting only one trial at each step or every other step in the program until an error occurs. If an incorrect response occurs, require three correct responses at that step before going on to the next step (see Continuing Errors).

What if the child's attention span is too short to complete even one threshold per session?

Decrease the number of trials per threshold by presenting one trial at every other level until the child makes an error (example: 20/250, 20/100, 20/60, 20/30). Once an error occurs follow the standard procedure of going up one line after an error and down one line after a correct response, until a threshold level is determined. Or after one threshold has been determined skip the larger sizes on subsequent thresholds (example: start with a 20/80 card). Every attempt should be made to complete an entire threshold at one sitting, as thresholds gathered from two or more sessions have not been validated.

What if the child says he "can't see it" during threshold testing?

The child should be encouraged to guess or pick one. Often they can proceed with testing beyond this point. A response should be recorded for each trial. If the child refuses to respond record NR for no response and move up one line to the next higher threshold size.

What if the child passes the pretest but does not respond or responds at random when the 20/250 threshold cards are presented?

The child may not be able to see the 20/250 threshold cards or he/she may not be generalizing the task to the smaller stimuli. Administer another pretest following the pretest procedures but using the 20/250 cards. This may help the child make the shift to smaller stimuli. If the child passes

a pretest with 20/250 cards or shows substantial improvement in correct responding, return to threshold testing. If the child continues to respond randomly or does not respond, adjust the cardtray to shorter test distances until correct responding occurs. Further distances and peripheral alignment of the cards may be tried. Note that anyone requiring such modifications of test distance should be referred. Screeners should state the unusual test arrangement on the screening report to the eye examiner.

What if the child was consistently pointing to the hand then starts making errors?

You could be at the child's threshold size, the child may not be generalizing the task to smaller stimuli, the child may be tired of the reinforcers being used or a number of other problems. See Unreliable Responding and Continuing Errors for some strategies for dealing with this situation.

What if the child seems to respond before looking at the pictures?

The screener can gently restrain the child's hand while instructing the child to look at all the pictures. The screener may also point to each picture and say, "Look here," moving to the next picture only after the child has looked where the screener is pointing. After the child has looked at each picture allow him/her to make a response.

Problems with Using the Equipment and Materials

What if the screener cannot see the small threshold sizes to determine if a correct response was made?

The screener can identify the position of the hand prior to the session and mark the correct position on the back of the card.

What if the cards get dirty?

The front of the cards are covered with a clear water repellent coating and can be wiped with a slightly damp cloth. The back of the card is not protected and should not be exposed to moisture.

Questions about Referral and Follow-up

What if the visual acuity scores are below the referral criterial (20/60 for preschool, 20/40 for school-aged and adult) but the child has observable signs of visual impairment (examples: nystagmus, muscle imbalance)?

Refer any child who has observable signs of visual impairment.

ROLES OF THE VISION SCREENER

This material was excerpted from: Vision Screening for Persons with Severe Handicaps. Pamela Cress, Charles R. Spellman, Terry J. DeBriere, Andrea C. Sizemore, Janice Northam and Janis L. Johnson, Journal of the Association for the Severely Handicapped, Fall, 1981.

The role of the vision screener goes beyond completing a screening test. The vision care process includes screening vision and making appropriate referrals, obtaining treatment and providing follow-up services. Previous sections of this manual have described procedures for using the PVAT. This section discusses the screener's role in making referrals, obtaining treatment and providing follow-up services.

Referral

Once the screener has completed tests for visual acuity and other screening procedures referral decisions must be made. For those preschool children who can perform on the PVAT, the recommended criteria for referral are scores of 20/60 or worse on two occasions (or other criteria specified by your agency or state). Other referrals would include those children with obvious eye muscle imbalance (eyes crossed, or an eye turned in or out of alignment with the other eye); excessive squinting, eye rubbing, watering eyes, or other signs of visual problems; and those who are unable to perform on acuity tests.

Treatment

The next major step is to obtain appropriate evaluation and treatment. Agencies wishing to establish vision care services which meet reasonable standards of quality should "shop around" to identify optometrists and/or ophthalmologists who are willing to, and, hopefully, experienced in, treating very young children and persons with handicaps. Untold frustration can result from the policy of "blind referrals" whereby the parents are told that there is a need for further evaluation and are then left to their own devices to select an examiner. Just as professionals in other fields have their specialties, some eye examiners are not willing or do not possess the necessary skills or equipment to treat very young and handicapped persons. Eye examiners with specialties in pediatric ophthalmology and optometry are often good choices for persons with handicaps.

Once eye examiners are identified who are willing to serve young children and persons with severe handicaps, it is advisable to assess their familiarity with the special needs of these persons. Many vision professionals are unfamiliar with the recent advancements in special education and other services to persons with handicaps, and they often underestimate

the need for adequate vision treatment for these persons. One critical topic for discussion is whether the eye examiner will use the same criterion for treatment as with so called "normal" patients. Some eye examiners use a less stringent criterion for treating young children and persons with severe handicaps because they apparently believe that such persons would not benefit from better vision or that such persons' behavioral preclude the use of glasses or other treatments. The vision screener or some other vision care advocate should discuss with the eye examiner the current expectations held by professionals serving young children with handicaps, as well as the typical programs and activities engaged in by these children. One should emphasize the importance of good vision in reaching the ultimate potential of persons with handicaps. Ideally, eye examiners should be located who are willing to use the same treatment criteria for patients with and without handicaps.

The screener or vision care advocate should also discuss with eye examiners the behavioral responses required by patients receiving an eye examination. Some young children will require training in necessary exam behaviors such as sitting in a hydraulic chair, fixating on a distant target, and tolerating the shining of light into the eyes. The screener or other concerned person may train these behaviors and/or accompany the child to the examination and assist by modeling, prompting, physically assisting, or reinforcing the desired response. The screener may also suggest alternative response and communication modes, correction procedures, etc., which the examiner could use with the child. Occasionally, some level of sedation is necessary to obtain a vision examination on persons with severe behavior problems. Valuable information can be obtained about person's visual system even when the person is anesthetized. Thus, the child's age or the severity of handicap does not preclude a professional eye examination.

Another aspect of obtaining treatment relates to the needs of persons with limited financial resources. Screeners should be familiar with the medical benefits available from state and federal sources in their locales and from other community resources such as the Lion's Club.

Obviously, an adequate vision screening system includes provisions for communicating the results of examinations and treatment decisions to the screener. This information will enable the screener to provide the next component in the vision care process, which is that of follow-up services.

Follow-Up Services

Although many young children and persons with severe handicaps do not require extensive training to benefit from vision treatment, some may not immediately adapt to wearing glasses, eye patches, or other somewhat intrusive treatments. These persons may require training in the placement, handling, and cleaning of glasses. Some persons may require individualized

behavior management programs to train the wearing of glasses, patches, etc., for extended periods. Parents, teachers, and other caregivers can participate in this component by providing follow-up training. For example, teachers could include programs to train the wearing of glasses in a student's individual education plan. Training materials could be provided to parents or other caregivers to develop or maintain these necessary skills in the home environment.

Before ordering lenses for the nonhandicapped patient, eye examiners typically administer visual acuity tests while systematically alternating between several different lenses which vary slightly from each other. This procedure allows the eye examiner to "fine tune" the original prescription by having the patient select the lens that provides the clearest image. This process also provides immediate feedback to the examiner regarding the accuracy of the original prescription. In the unlikely event that the eye examiner has made a significant error in the original prescription, this procedure serves as a safeguard against prescribing improper lenses. Since most eye examiners are unable to complete this phase when examining a young child or person with severe handicaps, the effects of the prescription lenses on visual acuity is unknown. If the vision screener and the eye examiner work closely together this problem can be eliminated. By placing the appropriate lenses in a trial lens frame or in the eyepiece of the Bernell-o-Scope and retesting visual acuity, screeners can allow young children and persons with severe handicaps to participate in this phase of the examination.

In practice, this level of cooperation and coordination is difficult to achieve. In most cases, omitting this phase of the examination is not critical to good vision care since the eye examiner's initial prescription generally corresponds closely to the one finally selected as a result of the process of "fine tuning." Additionally, any significant problems will be identified if the screener completes a follow-up visual acuity test soon after the glasses are received. This follow-up visual acuity test is also needed to safeguard against errors resulting from manufacturing and/or installing the lenses in the frame. Most eye examiners routinely check the accuracy of the prescription lenses with a lensometer, which allows a comparison of the prescription ordered with the one received from the manufacturer. This quality control measure identifies most manufacturer and installation errors. However, as a final safeguard many eye examiners retest visual acuity while patients are wearing their new glasses. The vision screener can provide this follow-up service by completing a visual acuity test while the person is wearing his or her new glasses. These data should also be shared with the eye examiner. It should be noted that some treatments may reduce eyestrain, eliminate headaches, or have other beneficial results without an improvement in acuity. Unusual cases should be discussed with the attending eye examiner.

The screener should be competent in interpreting the results of vision evaluations to parents, teachers, and other caregivers. Additionally, the screener should know when to recommend that the caregiver seek a second opinion or additional diagnostic assessment. Screeners

should be aware of the location of medical centers or other facilities with the capability of the most modern technological vision assessments, including optokinetic nystagmus (OKN), a technique utilizing reflexive eye movements to determine approximate acuity scores, and the visually evoked response (VER), similar to EEG measurement, which generates a visual display of cortical stimulation by a visual target. These assessments are used for diagnostic purposes and are somewhat extraordinary, but may, in some cases, provide valuable information about a person's vision system.

Screeners can provide useful information to teachers and other program designers who are uncertain about the vision capabilities of the learners they serve. Persons whose vision is not totally correctable may require modified learning environments, which can be greatly facilitated by a complete understanding of the results of screening, evaluation, and treatment decisions.

Summary

Most young children and persons with severe handicaps are not currently receiving adequate vision care. To remediate this problem, the article discusses three major components in the vision care process: 1) screening, 2) treatment, and 3) follow-up services. Information has been provided regarding each of these components and their relationship to the vision care process. Certain key points were made which should be understood by professionals serving young children and persons with severe handicaps, including the following:

1. All persons who have not had a recent eye examination should be referred to an optometrist or ophthalmologist for a comprehensive examination;

2. Persons who are unable to respond to acuity tests should be referred;

3. Eye examiners should be located who are willing to use the same treatment criteria for patients with and without handicaps;

4. The child's age or severity of handicap does not preclude a professional eye examination.

If vision screening systems are implemented which include the components discussed in this article, an immense obstacle to progress will have been removed, thus enabling persons with severe handicaps to reach their fullest potential. If your school or agency does not have a vision screening program, or has one that is inadequate, you are not alone. Efforts should begin now to provide these much needed services.

BACKGROUND INFORMATION REGARDING VISION

While about half the people in this country over three years of age wears some type of corrective lenses, available data on the incidence of visual impairment within the group of persons with mental and/or physical handicaps is even higher. The normally developing child relies heavily on vision for obtaining information; an undetected visual impairment can result in delays in motor, language, social and cognitive development. Thus, undetected visual impairments can compound the difficulties experienced by preschool children with mental and/or physical handicaps, and can blunt the effectiveness of the efforts of teachers and therapists who serve these children.

Unfortunately, existing vision screening programs have not been extended to preschool children with handicaps due to their inability to perform on standard screening tests. This manual provides instruction on administering one of the vision screening tools which can be effectively used with preschool children with handicaps.

The single most effective indicator of vision problems is visual acuity. Most vision screening instruments test visual acuity. Visual acuity is the measurement of the ability of the eye to perceive the shape of objects in direct line of vision and to distinguish detail. Most tests for visual acuity decrease the size of the test targets until the individual is no longer able to discriminate the figures correctly. Visual acuity tests are subjective in nature since they require an answer from the person taking the test.

Most visual acuity tests use a 20-foot distance as the standard distance for far-point testing. Results of tests at the 20-foot distance yield far-point scores or how well a child sees targets at a distance. In addition, the use of a near-point test at 13 to 16 inches will reveal how well a child sees at near-point or how well a child sees targets close to him. Both distances should be tested during a vision screening, if possible. It is extremely important to test each eye separately. Serious vision problems can occur when the eyes function or see differently from one another.

Visual acuity tests will reveal specific vision problems, the most common ones being refractive errors. A refractive error is a defect in the eye that prevents light waves from being brought to a single focus on the retina. One type of refractive error is known as hyperopia. Hyperopia or farsightedness occurs when the eye's focal point for light rays is focused behind the retina. High scores on near-point acuity tests may indicate hyperopia. A second type of refractive error is known as myopia. Myopia or near-sightedness occurs when the eye's focal point for light rays is in front of the retina. High scores on far-point acuity tests may indicate myopia. A third type of refractive error is astigmatism, which may affect visual acuity scores at either test distance.

A condition known as amblyopia may also be revealed by visual acuity tests. This condition may exist when there is a difference in visual acuity scores between the two eyes on either the near-point or far-point tests. There are three causes of amblyopia: 1) refractive error; 2) muscle imbalance; and 3) unknown etiology. The earlier an amblyopic condition is treated the better the results of that treatment. Treatment may consist of patching the better eye which will force the worst eye to work harder or treatment may consist of prescribing corrective lenses. Also, surgery may be indicated for amblyopia caused by muscular imbalance.

Another condition found through vision screening is eye muscle imbalance. Muscle imbalances, often called strabismus, are identified according to their degree (tropia-manifest or obvious imbalance or phoria-latent or occurring intermittently) and to the direction of deviation of the eye(s). The following is a list of common muscular imbalances defined according to degree and deviation:

1) exotropia - an obvious (manifest) turning out of either eye or both eyes

2) esotropia - an obvious (manifest) turning in of either or both eyes

3) hypertropia - an obvious (manifest) turning up of either or both eyes

4) exophoria - a tendency (latent) of either or both eyes to turn out

5) esophoria - a tendency (latent) of either or both eyes to turn in

6) hyperphoria - a tendency (latent) of either or both eyes to turn up

Any of these types of muscle imbalances may be constant, alternating (in one eye and then the other) or intermittent. A short "game" called the cover test may be used to find indications of muscle imbalance. To administer the cover test, cover one of the child's eyes with your hand, a paper cup, an eye patch, or whatever else is handy. Have the child watch a stationary object held at arms length from the eyes with the uncovered eye for a few seconds, then abruptly remove cover from the other eye. Any jerky shift to alignment or any misalignment of the covered eye fails the cover test. This procedure should be performed on each eye separately, preferably twice.

Another simple test for muscle imbalance is the corneal light reflex. A penlight is held at arm's length from the eyes being screened with the light directed at the bridge of the nose. The child being

screened should be instructed to look at the light. By observing the position of the reflected light in the two pupils the screener can determine if the eyes are properly aligned. The reflection should appear in a similar position in the two eyes; reflections which are located in dissimilar positions indicate a muscle imbalance.

In addition to vision problems indicated by visual acuity tests, vision screeners should be aware of other signs of visual difficulties. Some children fall into high risk categories for visual difficulty even when there is an absence of symptoms. Children with low birth weights, or whose family history includes vision problems, or children of rubella mothers are examples of groups at high risk for vision problems. Also some children show obvious signs of visual difficulty. Red, crusted rims, squinting, watery eyes, or tilting the head when doing close work are obvious indicators of vision problems. Children who fall into high risk categories or who show obvious signs of vision problems should be referred to a professional eye examiner.

The vision screener should refer children to an optometrist or ophthalmologist. An optometrist will measure refractive error and prescribe corrective lenses. They may or may not use drugs to dilate the pupil depending upon the laws of their respective state. An ophthalmologist is a medical doctor whose primary concern is the physical health of the eye and who may perform surgery and/or treat eye disease as well as measure refractive error and prescribe lenses. Ophthalmologists routinely use drugs for dilation of the eyes.

The vision screener should share the results of the vision screening with the parents and the eye examiner. Results of acuity testing are invaluable to the eye examiner in terms of effectiveness of various treatments and some treatment decisions may be based solely on acuity scores.

Both optometrists and ophthalmologists will do a complete objective examination. The exam is objective since it is not necessary for the child to respond in order to obtain information about the eye. The examination will include a retinoscopy which measures the eyes' refractive error by observing movement of light and shadows across the pupil by light shone onto the retina from a moving mirror. The eye examiner determines the shape and strength of the lens that will allow light to focus directly on the retina. From this information a treatment decision is made (usually whether or not to prescribe glasses). In addition, the eye examiner will complete an ophthalmoscopy which examines the interior of the eye for structural irregularities or eye disease. Ophthalmologists and some optometrists may use cycloplegic drugs to paralyze the ciliary muscles and fully dilate the pupil allowing the eye examiner a view of the interior of the eye with minimal cooperation from the child.

Results of the objective exam should be obtained by the vision screener if at all possible. The screener should be able to read the treatment prescription and know whether or not the referral was correct.

The prescription of the lens is written in three parts: sphere; cylinder; and axis. The sphere indicates the degree of myopia or hyperopia to be corrected. The cylinder indicates the degree of astigmatism to be corrected. The axis indicates the location of the astigmatism on the lens. Thus, a -2.50 + .75 X 90° is a minus sphere of two and one-half diopters (measure of strength of lens) for correction of myopia with a cylinder of three quarters of a diopter for correcting astigmatism and an axis of 90° for the location of the astigmatic correction on the lens.

The vision screener is an integral part of the vision treatment process. Cooperation between the professional eye examiner and the vision screener will enhance the likelihood that the child will receive adequate vision services.